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BULLETIN 656 JANUARY 1963

Mississippi Hybrid Corn Tests, 1962

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COOPERATIVE PROJECT

Corn breeding and testing in Mississippi is a cooperative project between the U. S. Department of Agriculture and the Mississippi Agricultural Experiment Station. In addition to Dr. Grogan and Dr. Campbell, who are listed as authors of this report, the following research men supervised the tests at the various branch stations or participated in it at State College:

Donald H. Bowman, agronomist, Delta Branch Experiment Station, Stoneville.

W. A. Douglas, and C. A. Henderson, entomologists, U.S.D.A., State College, Mississippi.

S. P. Crockett, superintendent, North Mississippi Branch Station, Holly Springs.

Robert C. Albritton, superintendent, Northeast Mississippi Branch Station, Verona.

B. C. Hurt, superintendent, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

Louie Walton, superintendent, Black Belt Branch Station, Brooksville.

B. E. Waggoner, asst. agronomist, Coastal Plain Branch Station, Newton.

Robert E. Coats, agronomist, Brown Loam Branch Station, Raymond.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

Three of the tests were on private farms through the cooperation of P. F. Williams, Jr., Clarksdale; E. T. Schaefer, Yazoo City; and M. A. Luter, Tylertown.

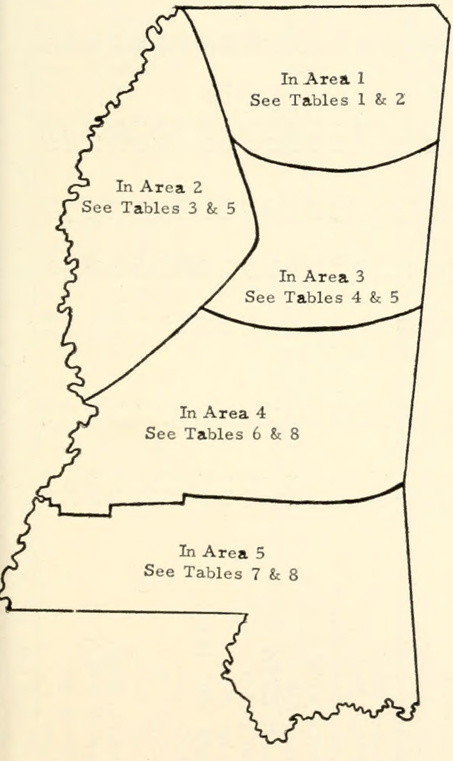
1962 HYBRID CORN TESTS

By C. O. GROGAN and C. M. CAMPBELL[1]

Mississippi as a whole experienced an unfavorable season for corn production. However, there were isolated areas that had reasonably good rainfall distribution during the growing season, and often these were within a few miles of an area where the opposite conditions existed. Two tests were not harvested and the yields of some others were considerably below average.

The tests were grouped differently in 1962 than in the past. Previously the tests were grouped in three broad regions —northern, central, and southern.

Under the new system, the testing area of the state was divided into five areas, each representing a different set of environmental conditions. At least two tests were planted in each area. No restrictions were placed on the commercial companies as to number or which hybrids to enter. This system permitted the entry of hybrids that were in the advanced experimental stage and hybrids that might be particularly well adapted to Mississippi. It is believed the new policy will mean better hybrids for Mississippi farmers.



At least five replications were planted as a randomized block at each location, or the test was a balanced lattice with six replications. Individual plots consisted of 10 hills planted in 2-by-5 hill checks to facilitate ease of planting, thinning, taking notes, and greater accuracy in statistical computations. Tests have shown that comparable yields for a given plant population are obtained with either check or drill planting.

Notes were taken on yield, lodging, ear height, ears per plant, moisture, stand and insect reaction. Normally one is concerned primarily with yield. Growers should not consider just one year at one location, but rather the area yield and particularly the performance for a period of years. The best estimate of what to expect from a hybrid is that obtained from at least a three-year average which permits the subjection of the hybrids to a variety of climatic conditions.

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[1] Agronomists, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture; and Mississippi Agricultural Experiment Station, cooperating. Cooperative research also was with the Entomology Division, Agricultural Research Service, U. S. Department of Agriculture. The tests were conducted jointly with the Branch Experiment Stations and on three private farms. See opposite page.

Table 1.—1962 Summary performance of the main hybrids tests in Area 1 (Holly Springs, Verona, and Pontotoc).

		Lodging						Earworm		P.C.W.[2]	Husk		Corn Borer	
Pedigree	Acre yield	Root	Stalk	Ear ht.	Ears per plant	Moist. in grain	Stand	Penetration[1]	Ears infested	ears infested	Extension[3]	Tightness[4]	plants infested	Plants girdle & broken
	Bu.	%	%	ft.	no.	%	%	in.	%	%	in.	in.	%	%
Pioneer 9187	79.8	0.9	17.9	3.9	1.6	13.4	94	1.1	70	50	2.2	0.70	38.3	13.3
Pioneer 8224	77.8	0.7	9.8	3.6	1.5	13.5	96	0.8	70	60	2.9	0.68	26.7	3.3
Funk's G-795W	76.4	0.8	3.1	3.4	1.6	12.8	89	1.0	90	60	2.8	0.75	8.3	1.7
Miss 6135 (Exp.)	75.5	1.0	3.2	4.0	1.6	12.7	94	1.4	90	70	2.9	0.63	25.0	6.7
Pioneer 309B	74.0	1.5	4.1	3.4	1.3	12.9	95	1.1	100	80	2.1	0.75	33.3	13.3
Stull's 111YA	73.1	4.0	7.6	4.2	1.2	12.9	94	1.4	90	80	2.6	0.73	18.3	8.3
Dixie 22	73.1	1.7	10.4	4.1	1.3	13.2	94	1.3	70	50	2.7	0.73	25.0	10.0
McNair 444B	73.1	3.4	8.5	3.8	1.4	13.2	94	1.3	70	40	2.0	0.83	16.7	5.0
Dixie 55	71.8	1.1	5.9	4.2	1.4	13.2	93	1.5	100	90	2.5	0.63	23.3	8.3
Dixie 77	71.5	5.0	9.3	3.7	1.5	13.0	90	1.0	80	80	2.8	0.70	15.0	3.3
Delta 8812 (Exp.)	71.2	6.1	11.5	3.8	1.4	13.5	93	0.9	80	70	3.5	0.58	11.7	8.3
Miss 6133 (Exp.)	71.1	2.0	10.9	3.8	1.6	12.3	90	1.2	80	70	2.7	0.75	26.7	6.7
Embro Jarvis E	70.2	7.8	14.6	3.0	1.1	12.9	94	1.5	90	50	3.5	0.60	18.3	8.3
Embro Departure VIII	69.8	10.2	17.5	3.5	2.5	12.7	92	0.5	60	50	2.1	0.70	11.7	8.3
Delta 0234 (Exp.)	69.7	2.8	2.5	3.5	1.3	13.1	91	1.2	70	60	2.9	0.68	13.3	6.7
Pioneer 509W	69.7	0.9	10.0	3.3	1.3	12.1	92	2.0	100	100	4.0	0.50	21.6	10.0
Pioneer 310	68.3	0.8	7.2	3.1	1.1	12.2	92	1.5	100	80	2.2	0.78	18.3	8.3
Funk's G-711AA	67.8	1.9	5.6	3.7	1.1	13.5	92	2.0	80	60	1.2	1.15	26.7	6.7
McCurdy M98L	67.0	1.9	12.1	3.7	1.1	12.5	91	1.2	80	60	2.8	0.78	23.3	10.0
Pioneer 309A	67.0	0.3	3.5	3.4	1.1	12.8	96	1.2	80	50	2.1	0.76	18.3	3.3
McNair 304A	66.7	2.2	2.8	3.2	1.2	13.0	91	1.2	80	90	1.9	0.93	10.0	3.3
Embro Jarvis Star	66.6	3.4	12.8	3.6	1.2	13.1	92	1.2	80	70	2.7	0.73	13.3	6.7
Stull's 500W	66.2	1.6	14.6	3.2	1.1	12.7	89	2.5	100	90	2.3	0.73	15.0	6.7
Coker 616	65.4	2.6	7.4	3.3	1.3	13.4	92	1.4	90	70	2.1	0.71	23.3	13.3
Embro 222TA	65.1	0.5	4.8	4.0	1.0	13.5	92	1.4	80	80	3.1	0.78	18.3	10.0
Stull's 111Y	64.8	4.3	11.3	3.8	1.1	12.7	95	1.9	90	70	1.2	1.28	18.3	1.7
Coker 15	64.7	3.6	6.3	3.1	1.4	12.3	92	1.4	90	70	2.4	0.80	13.3	0.0
Delta 9907 (Exp.)	64.5	1.2	2.8	4.1	1.5	13.4	70	1.2	60	60	2.1	0.73	16.7	5.0
Stull's 108Y	63.0	0.2	3.8	3.9	1.0	12.5	94	3.1	100	100	0.7	1.38	11.7	5.0
DeKalb 925	62.2	1.5	12.3	3.2	1.1	12.4	94	1.4	80	70	2.4	0.75	20.0	5.0
Funk's G-702	61.6	1.8	11.1	3.0	1.1	12.3	95	2.8	100	90	1.8	0.98	25.0	15.0
DeKalb 1004	58.9	4.5	10.8	3.6	1.1	12.2	92	2.2	90	100	1.9	0.95	36.7	15.0
DeKalb 1003	56.6	1.9	7.7	3.6	1.1	12.1	91	2.3	90	80	1.4	1.00	6.7	5.0
DeKalb 805	54.2	3.5	6.6	2.8	0.9	12.2	89	1.6	100	100	2.5	0.90	20.0	5.0
Mean	68.3	2.6	8.8	3.6	1.3	12.8	92	1.5	85	72	2.4	0.80	19.7	7.3

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear.

*Insect data from Holly Springs, only. One replication except for Southwestern Corn Borer. Exp. means experimental hybrid not commercially

One important factor in yield is the ability of the hybrids to stand erect until harvest. Frequently some hybrids have very high yield but inherent susceptibility to lodging reduces the amount harvested. Losses stem not only from ears missed during harvest but also from rotting and rodents when the ears are on or near the ground.

The height of the ear merits some consideration when the corn is to be picked by hand or with some types of mechanical harvesters. In some cases excessive ear height contributes to lodging where the extra burden by the weight and position of the ear is sufficient to cause the stalk to fall.

Early Planting Favored

Grain moisture is generally not a problem in Mississippi unless the corn is planted late. Under some conditions, diseases may be serious where grain moisture is excessive. Planting corn late enough where the grain moisture will be high at the normal harvesting date is not recommended. Tests have shown that late-planted corn is usually lower in yield, has more lodging, and will be badly infested with insects. These tests have shown also that corn can be safely planted before, and harvested before, cotton and at the same time get higher yields than if planted after cotton.

The number of ears per plant indicat-

Table 2.—1962 and three-year average yields in bushels per acre for hybrids grown in Area 1.

Hybrid	Area Mean	Holly Springs	Verona	Pontotoc Ridge	Pontotoc Flatwoods	3-year mean
Pioneer 9187	79.8	83.6	69.3	92.3	73.8	----
Pioneer 8224	77.8	80.1	70.3	84.6	76.1	----
Funk's G-795W	76.4	89.3	63.4	82.8	70.0	----
Miss 6135 (Exp.)	75.5	84.0	55.5	86.8	75.6	----
Pioneer 309B	74.0	72.3	66.2	80.8	76.8	71.1
Stull's 111YA	73.1	67.5	64.8	89.4	70.7	----
Dixie 22	73.1	77.6	56.4	81.5	76.9	70.2
McNair 444B	73.1	79.7	61.3	78.4	73.1	----
Dixie 55	71.8	69.0	61.5	81.3	75.4	73.0
Dixie 77	71.5	76.6	47.3	89.6	72.6	71.0
Delta 8812 (Exp.)	71.2	78.9	55.5	79.4	70.9	70.4
Miss 6133 (Exp.)	71.1	85.6	47.4	82.7	68.5	70.7
Embro Jarvis E	70.2	73.6	57.1	83.5	66.4	----
Embro Departure VIII	69.8	76.9	55.9	72.7	73.7	----
Delta 0234 (Exp.)	69.7	74.2	52.2	89.8	62.4	----
Pioneer 509W	69.7	62.9	58.1	85.9	71.9	----
Pioneer 310	68.3	69.5	60.1	74.2	69.3	----
Funk's G-711AA	67.8	72.3	57.5	74.3	67.0	68.0
McCurdy M98L	67.0	70.4	62.8	74.1	60.5	----
Pioneer 309A	67.0	70.1	61.8	73.6	62.3	66.3
McNair 304A	66.7	67.8	55.7	74.9	68.5	----
Embro Jarvis Star	66.6	66.8	54.8	85.4	59.3	----
Stull's 500W	66.2	67.7	51.1	81.3	64.7	----
Coker 616	65.4	75.8	48.5	77.8	59.3	65.7
Embro 222TA	65.1	68.1	52.8	72.0	67.4	----
Stull's 111Y	64.8	65.4	54.1	74.5	65.1	----
Coker 15	64.7	68.9	48.4	74.8	66.6	----
Delta 9907 (Exp.)	64.5	76.5	45.0	73.6	62.7	----
Stull's 108Y	63.0	60.0	60.0	70.3	61.6	----
DeKalb 925	62.2	65.7	59.0	69.0	55.1	----
Funk's G-702	61.6	63.2	54.3	68.2	60.7	----
DeKalb 1004	58.9	64.4	49.5	67.5	54.2	----
DeKalb 1003	56.6	56.9	46.4	64.2	58.7	----
DeKalb 805	54.2	59.4	40.8	60.6	55.9	----
Mean	68.3	71.9	56.1	78.1	66.9	----
LSD 5%		11.4	11.6	9.9	11.6	----

Table 3.—1962 Summary performance of the main hybrid tests in Area 2 (Stoneville and Clarksdale)

Pedigree	Acre yield bu.	Lodging Root %	Lodging Stalk %	Ear ht. ft.	Ears per plant no.	Stand %	Earworm Husk Penetration[1] in.	Earworm Husk Extension[2] in.
Miss. 0002 (Exp.)	90.5	0	8	4.7	1.5	98	0.9	3.8
Pioneer 9187	87.4	0	17	3.8	1.3	100	1.7	2.7
Pioneer 8218	86.3	0	5	3.9	1.2	100	1.2	3.5
DeKalb 1225	84.3	0	12	4.7	1.4	98	0.5	3.4
Coker 67	83.7	0	3	4.0	1.4	100	0.7	2.9
Dixie 77	81.1	0	10	3.9	1.4	96	1.2	2.5
McCurdy M97	80.7	0	7	3.8	1.1	100	2.4	1.7
Embro Departure IV	80.5	0	9	4.4	1.9	94	0.9	3.4
Funk's G-795W	77.3	0	14	3.9	1.4	91	1.0	3.5
Coker 911	76.3	0	5	4.0	1.1	100	1.2	3.1
Dixie 55	75.5	0	5	4.1	1.4	85	1.1	3.9
McCurdy 999	75.3	0	10	3.6	1.1	100	1.8	2.8
Embro 222TA	74.5	0	8	4.1	1.1	98	2.1	2.1
Delta 8812 (Exp.)	74.0	0	19	3.9	1.3	97	0.9	3.4
Pioneer 8224	73.9	0	9	3.7	1.2	96	1.2	3.1
Pioneer 309B	72.2	0	7	3.4	1.1	93	1.3	2.6
Pioneer 509W	72.0	0	8	3.5	1.2	94	2.5	2.5
Funk's G-710AA	71.4	0	10	4.0	1.1	98	2.0	2.6
Delta 0234 (Exp.)	70.4	0	4	3.5	1.1	87	0.9	3.5
Funk's G-711AA	69.0	0	14	3.9	1.1	96	1.5	2.0
McCurdy M991	68.9	0	21	3.8	1.1	95	1.4	2.9
Dixie 22	68.5	0	6	4.3	1.2	86	1.4	2.8
DeKalb 1004	64.9	0	10	3.8	1.1	93	3.4	1.8
DeKalb 1003	64.1	0	8	3.9	0.9	96	3.7	0.9
Delta 9907 (Exp.)	49.7	0	8	4.1	1.3	54	0.8	3.0
Mean	74.9	0	9	3.9	1.2	94	1.5	2.8

[1]Inches from tip of ear. [2]Inches beyond tip of ear.

Moisture in grain at harvest of all hybrids was less than 12.0%

es prolificy. A prolific hybrid can better adjust to the environment under which it is growing than a non-prolific (single ear) hybrid. Under adverse conditions, a prolific hybrid may produce only one ear per plant, but under good environmental conditions, two or more ears per plant may be produced with the same plant density.

The insect notes were taken by Mr. W. A. Douglas and C. A. Henderson, USDA entomologists. Insect ratings are important considerations in selecting hybrids. Often resistance is the difference between profit and loss. The Southwestern corn borer is commanding more attention in Mississippi. Research is in progress to determine methods of control.

In selecting a hybrid, the point of comparing yields over a period of years should be kept firmly in mind. The corn grower who plants all of his acreage to a hybrid based on the performance of only one test year takes a risk. If he wishes to try a hybrid because of a particularly outstanding performance, he should plant only a part of that acreage to that hybrid and the remainder of the land to one that is known to be consistently good. Insect resistance, lodging, and other agronomic features which determine the harvestable yield should be considered. Study carefully the performance records of 1962 before selecting a hybrid for 1963.

Table 4.—1962 summary performance of the main hybrid tests in Area 3 (State College and Brooksville)

Pedigree	Acre yield	Lodging		Ear ht.	Ears per plant	Moist. in Grain	Stand	Earworm		P.C.W.[2] ears infested*	Husk	
		Root	Stalk					Penetration[1]	Ears infested		Extension[3]	Tightness[4]
	bu.	%	%	ft.	no.	%	%	in.	%	%	in.	in.
Funk's G-711AA	93.9	5.7	7.1	3.8	1.3	12.3	98	1.3	84	93	2.5	0.78
Miss. 0002 (Exp.)	93.7	3.7	5.3	4.3	1.6	13.1	97	1.2	83	90	3.7	0.62
Funk's G-732	93.6	3.4	2.2	4.0	1.5	13.7	97	1.1	88	95	2.9	0.69
Funk's G-795W	93.2	4.1	5.6	3.9	1.5	12.2	98	1.0	87	95	3.1	0.64
Pioneer 8218	92.4	0.0	1.8	4.0	1.3	13.3	100	1.1	83	93	3.3	0.65
Funk's G-720	91.4	1.4	1.3	4.0	1.2	12.7	100	1.0	75	93	2.9	0.66
Delta 0234 (Exp.)	91.1	3.8	4.7	3.9	1.5	12.6	98	1.0	75	95	3.6	0.58
Funk's G-730	90.6	2.8	3.5	4.0	1.3	12.6	100	1.0	82	95	3.0	0.77
Pioneer 309B	90.4	0.9	2.5	3.7	1.3	12.7	99	1.1	86	93	2.8	0.64
Dixie 82	89.6	3.7	7.7	4.3	1.5	12.9	96	1.3	86	90	3.4	0.65
Pioneer 9187	89.3	3.1	15.5	4.0	1.5	13.0	100	1.1	89	90	2.9	0.68
Dixie 55	88.5	2.6	4.0	4.3	1.5	13.4	91	1.0	70	78	3.7	0.60
Pioneer 8224	88.1	1.3	7.5	3.7	1.5	13.3	98	1.0	84	90	2.7	0.70
McNair 444B	87.0	8.3	3.7	4.1	1.5	13.0	98	1.1	87	93	3.1	0.66
Dixie 22	86.3	2.8	10.9	4.2	1.4	13.4	94	1.2	91	93	3.0	0.72
McCurdy 999	86.0	4.5	6.0	3.8	1.2	12.5	100	1.1	82	98	3.1	0.66
Delta 9907 (Exp.)	85.1	1.2	1.4	4.1	1.5	13.5	74	1.3	93	98	2.8	0.74
Embro 256CP	83.9	1.2	3.8	4.4	1.3	13.4	99	0.8	71	90	3.4	0.58
McNair 425	82.9	6.1	5.3	3.9	1.4	13.4	98	1.3	92	98	2.9	0.69
Delta 8812 (Exp.)	82.8	3.5	10.9	4.0	1.5	12.6	98	0.8	69	90	3.7	0.58
Coker 67	82.1	3.8	4.6	4.1	1.5	13.4	97	0.8	72	95	3.4	0.63
DeKalb 1004	82.0	6.5	14.6	3.9	1.1	12.7	95	1.0	83	93	3.1	0.72
Dixie 18	79.7	2.9	5.3	4.6	1.4	13.5	98	0.8	61	85	3.7	0.57
Coker 911	79.4	6.6	2.3	3.8	1.3	13.1	98	0.9	82	98	3.0	0.64
DeKalb 1003	79.0	4.9	5.9	3.9	1.1	12.6	99	1.3	93	100	2.2	0.78
Mean	87.3	3.5	5.7	4.1	1.4	13.0	97	1.1	82	93	3.1	0.63

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. *Brooksville only.

Table 5.—1962 and three-year average yields in bushels per acre for hybrids grown in Areas 2 and 3.

	Area 2			
Hybrid	Area-mean	Stone-ville	Clarks-dale	3-Year mean
Miss. 0002 (Exp.)	90.5	82.7	98.3	-----
Pioneer 9187	87.4	81.7	93.0	-----
Pioneer 8218	86.3	79.8	92.8	-----
DeKalb 1225	84.3	80.2	88.4	-----
Coker 67	83.7	75.5	91.8	-----
Dixie 77	81.1	83.6	78.5	98.3
McCurdy M97	80.7	86.8	74.6	-----
Embro Departure IV	80.5	76.3	84.7	-----
Funk's G-795W	77.3	75.0	79.6	-----
Coker 911	76.3	71.8	80.8	-----
Dixie 55	75.5	71.9	79.0	99.5
McCurdy 999	75.3	77.4	73.2	90.8
Embro 222TA	74.5	70.8	78.1	-----
Delta 8812 (Exp.)	74.0	72.1	75.8	99.1
Pioneer 8224	73.9	74.6	73.1	-----
Pioneer 309B	72.2	72.0	72.4	93.3
Pioneer 509W	72.0	77.5	66.5	-----
Funk's G-710AA	71.4	76.1	66.6	94.6
Delta 0234 (Exp.)	70.4	67.2	73.6	-----
Funk's G-711AA	69.0	75.2	62.7	88.8
McCurdy M991	68.9	71.5	66.3	-----
Dixie 22	68.5	70.8	66.2	96.3
DeKalb 1004	64.9	61.6	68.2	-----
DeKalb 1003	64.1	74.0	54.1	-----
Delta 9907 (Exp.)	49.7	58.4	41.0	-----
Mean	74.9	73.5	75.2	-----
LSD 5%		9.6	11.2	-----

	Area 3			
Hybrid	Area mean	State College	Brooks-ville	3-Year mean*
Funk's G-711AA	93.9	90.2	97.6	-----
Miss 0002 (Exp.)	93.7	97.6	89.8	-----
Funk's G-732	93.6	89.2	97.9	-----
Funk's G-795W	93.2	97.9	88.4	-----
Pioneer 8218	92.4	87.4	99.4	-----
Funk's G-720	91.4	82.1	100.6	-----
Delta 0234 (Exp.)	91.1	88.8	93.3	-----
Funk's G-730	90.6	85.8	95.3	81.0
Pioneer 309B	90.4	90.0	90.8	76.8
Dixie 82	89.6	88.4	90.8	82.4
Pioneer 9187	89.3	93.5	85.1	-----
Dixie 55	88.5	90.4	86.6	78.1
Pioneer 8224	88.1	85.0	91.2	-----
McNair 444B	87.0	86.7	87.2	-----
Dixie 22	86.3	86.5	86.1	79.9
McCurdy 999	86.0	82.1	89.9	-----
Delta 9907 (Exp.)	85.1	81.3	88.9	-----
Embro 256CP	83.9	85.9	81.9	-----
McNair 425	82.9	83.0	82.7	-----
Delta 8812 (Exp.)	82.8	87.4	78.1	-----
Coker 67	82.1	82.1	82.1	71.9
DeKalb 1004	82.0	83.8	80.1	-----
Dixie 18	79.7	84.4	74.9	70.5
Coker 911	79.4	82.0	76.8	69.4
DeKalb 1003	79.0	77.7	80.3	-----
Mean	87.3	86.7	87.8	-----
LSD 5%		10.1	7.1	-----

*Brooksville only

Table 6.—1962 summary performance of the main hybrid tests in Area 4 (Raymond and Yazoo City).

Pedigree	Acre yield	Lodging		Ear ht.	Ears per plant	Moist. in Grain	Stand	Earworm Penetration[1]
		Root	Stalk					
	bu.	%	%	ft.	no.	%*	%	in.**
Funk's G-795W	54.0	1.5	35.8	3.7	1.3	10.5	94	1.0
Funk's G-745	54.0	5.5	34.8	4.5	1.1	11.0	100	1.2
Embro Low Boy	53.4	1.5	33.6	3.5	1.1	10.3	97	1.0
Miss 0002 (Exp.)	52.1	0.0	36.2	4.3	1.2	10.7	93	1.3
Funk's G-740	51.9	4.4	43.9	4.7	1.1	10.5	96	1.3
Pioneer 9187	49.8	0.0	49.0	3.6	1.0	10.4	96	1.8
Coker 811A	48.9	0.0	23.6	3.7	1.2	10.2	95	0.6
McCurdy M301-1	48.3	1.0	44.8	4.8	1.0	9.8	91	1.0
McNair 444B	47.7	1.5	42.5	4.1	1.1	10.1	98	1.0
Pioneer 8226	47.4	3.4	23.4	4.2	0.9	11.1	95	0.7
McCurdy 1003C	47.4	3.0	48.5	4.6	1.0	10.1	93	0.8
Funk's G-732	47.1	5.0	26.1	4.3	1.0	10.7	97	1.0
Pioneer 309B	46.8	1.0	36.4	3.4	1.0	10.6	92	1.3
Dixie 22	46.4	0.0	38.2	4.6	1.1	10.7	91	1.7
Dixie 82	46.2	2.5	32.3	4.4	1.0	10.6	88	1.0
McCurdy 999	45.7	0.5	47.6	3.8	1.0	11.1	93	1.3
Coker 67	45.5	3.5	14.4	4.3	1.2	11.1	91	0.6
McNair 425	45.4	1.5	33.7	4.3	1.1	10.5	96	1.3
Funk's G-730	45.4	3.0	28.6	3.7	1.0	10.8	97	1.5
Embro 261	45.0	2.0	35.0	4.1	1.0	10.6	92	0.8
Greenwood 471	44.8	3.0	35.7	4.4	1.1	10.5	96	0.7
Coker 71	44.0	1.0	12.8	4.2	1.0	10.8	98	0.5
DeKalb 1225	43.8	11.5	29.9	5.0	1.0	10.8	89	0.5
Dixie 18	43.7	4.5	34.1	4.8	1.1	10.7	88	0.5
Embro Departure V	43.4	3.5	44.1	4.1	1.6	10.5	98	1.0
Embro 256CP	43.0	1.5	39.9	4.7	1.0	10.7	90	0.8
Coker 911	41.9	2.0	33.7	4.0	1.0	10.8	96	0.8
Greenwood 18	40.1	3.0	31.3	4.8	1.0	11.0	96	0.7
Mean	46.9	2.5	34.6	4.2	1.1	10.6	94	1.0

[1] Inches from tip of ear.

*Raymond only

**Yazoo City only

The performance of NC288 and Dixie 55 was not determined at Yazoo City because of a poor stand.

Table 7.—Summary performance of the main hybrid test grown at Poplarville (Exp. 212)
Area 5

Pedigree	Acre yield	Lodging		Ear ht.	Ears per plant	Moist. in Grain	Stand	Earworm		P.C.W.[2]	R.W.[3]
		Root	Stalk					Penetration[1]	Ears infested	ears infested	ears infes.
	bu.	%	%	ft.	no.	%	%	%	in.	%	%
Miss 8288 (Exp.)	74.5	20.7	5.8	4.2	1.6	12.6	100	1.1	83	100	48
Miss 8484 (Exp.)	73.9	18.8	9.8	4.2	1.6	12.6	100	1.0	60	100	23
Dixie 18	73.4	37.9	5.2	3.9	1.7	12.6	97	0.5	43	100	5
Embro Flint-1	73.2	23.1	8.3	3.8	1.6	12.9	100	0.7	53	100	15
DeKalb 1225	72.1	62.3	8.2	4.1	1.6	12.8	100	1.0	65	100	28
Coker 67	70.9	26.2	8.2	3.1	1.7	13.2	100	0.9	63	100	13
Coker 811A	70.5	13.3	2.5	3.1	1.8	13.0	100	0.8	50	100	8
Coker 811	69.4	35.8	10.0	3.3	1.8	12.6	100	0.6	50	100	15
Pioneer 9187	69.0	17.1	17.9	2.7	1.5	13.2	100	1.2	80	100	23
Funk's G-745	69.0	25.2	11.0	3.3	1.4	12.8	100	1.5	85	100	23
Funk's G-795W	68.4	6.6	13.2	2.3	1.7	12.7	100	1.4	93	100	29
Miss 6004 (Exp.)	66.7	11.2	14.7	3.8	1.5	12.8	97	0.8	60	100	13
Coker 71	66.4	23.8	5.6	3.1	1.5	12.8	100	0.9	73	100	35
Greenwood 471	65.6	22.8	8.1	3.4	1.5	12.3	100	0.8	65	100	8
Funk's G-732	65.1	22.0	5.1	2.8	1.6	12.6	98	1.2	85	100	30
Keystone 257	65.1	14.4	19.2	3.5	1.4	13.0	100	0.8	70	100	35
McNair 425	65.1	41.3	17.4	3.0	1.6	13.1	100	1.3	90	100	20
Miss 6002 (Exp.)	64.0	13.5	16.2	3.8	1.5	13.1	93	1.0	53	100	8
Funk's G-740	62.7	23.3	24.2	3.8	1.4	13.5	100	1.1	75	100	23
Embro 76-24	62.6	27.8	27.0	3.4	1.8	13.6	96	0.9	73	100	30
Greenwood 18	60.8	33.0	13.9	3.6	1.4	12.9	96	0.9	70	100	18
Dixie 55	59.5	18.2	12.1	3.4	1.6	12.6	83	1.1	83	100	30
Embro 260	58.7	21.9	13.2	3.7	1.4	13.5	95	0.8	68	100	25
Miss 8305 (Exp.)	51.5	25.3	16.1	4.0	1.5	12.7	73	0.3	30	100	13
Miss 6115 (Exp.)	51.2	47.4	2.1	4.1	1.2	12.5	81	0.9	53	100	35
Mean	66.0	25.3	11.8	3.5	1.6	12.9	96	0.9	67	100	22
LSD, 5%	8.1										
C.V. 10.8%											

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[1] Inches from tip of ear. [2] Pink corn worm. [3] Rice weevil.

Table 8.—1962 and three-year average yields in bushels per acre for hybrids grown in Areas 4 and 5.

Area 4					Area 5 (Poplarville only)		
Hybrid	Area mean	Ray-mond	Yazoo City	3-year mean	Hybrid	Area mean	3-Year mean
Funk's G-795W	54.0	44.2	63.8	......	Miss 8288 (Exp.)	74.5	61.7
Funk's G-745	54.0	43.8	64.1	......	Miss 8484 (Exp.)	73.9	61.1
Embro Low Boy	53.4	38.4	68.3	......	Dixie 18	73.4	58.6
Miss 0002 (Exp.)	52.1	35.7	68.4	......	Embro Flint-1	73.2	......
Funk's G-740	51.9	42.9	60.8	......	DeKalb 1225	72.1	57.5
Pioneer 9187	49.8	45.2	54.4	......	Coker 67	70.9	61.0
Coker 811A	48.9	37.1	60.7	......	Coker 811A	70.5	......
McCurdy M301-1	48.3	39.3	57.2	......	Coker 811	69.4	57.8
McNair 444B	47.7	43.4	51.9	......	Pioneer 9187	69.0	......
Pioneer 8226	47.4	34.0	60.8	......	Funk's G-745	69.0	......
McCurdy 1003C	47.4	38.6	56.1	66.3	Funk's G-795W	68.4	......
Funk's G-732	47.1	36.3	57.9	......	Miss 6004 (Exp.)	66.7	58.1
Pioneer 309B	46.8	34.5	59.0	64.5	Coker 71	66.4	55.9
Dixie 22	46.4	33.2	59.6	67.5	Greenwood 471	65.6	......
Dixie 82	46.2	31.5	60.9	76.9	Funk's G-732	65.1	......
McCurdy 999	45.7	40.4	50.9	......	Keystone 257	65.1	48.2
Coker 67	45.5	34.8	56.1	68.8	McNair 425	65.1	......
McNair 425	45.4	35.9	54.8	......	Miss 6002 (Exp.)	64.0	......
Funk's G-730	45.4	34.3	56.5	65.8	Funk's G-740	62.7	53.0
Embro 261	45.0	32.6	57.4	......	Embro 76-24	62.6	......
Greenwood 471	44.8	33.5	56.0	......	Greenwood 18	60.8	......
Coker 71	44.0	33.6	54.4	64.2	Dixie 55	59.5	55.6
DeKalb 1225	43.8	26.5	61.0	67.5	Embro 260	58.7	......
Dixie 18	43.7	29.7	57.6	68.3	Miss 8305 (Exp.)	51.5	47.6
Embro Departure V	43.4	31.6	55.2	......	Miss 6115 (Exp.)	51.2	48.2
Embro 256CP	43.0	30.3	55.7	......	Mean	66.0	......
Coker 911	41.9	27.6	56.1	66.4	LSD 5%	8.1	......
Greenwood 18	40.1	27.1	53.0	......			
Dixie 55	......	33.4	......	......			
NC288	......	28.7	......	......			
Mean	46.9	35.3	58.2	......			
LSD 5%	......	10.0	N.S.	......			

BULLETIN 657 JANUARY 1963

Mississippi Cotton Variety Tests, 1962

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Stoneville

Table 1.—Yield, gin turn out, boll size, staple length, strength, elongation, micronaire, and gross value per acre for the 1962 cotton variety test at Stoneville, Mississippi.

Variety	Yield per acre		Percent	Number bolls per pound		Fiber Properties					Gross value
	Seed cotton	Lint	Lint	Seed cotton	Lint	Staple length Classer	Staple length UHM	Strength (T$_1$)	Elongation (E$_1$)	Micronaire	per acre (SLM)
	lbs.	lbs.	pct.	no.	no.	inch	inch	index	index	index	dollars
Stoneville 213	3341	1323	39.6	72	182	1 3/32	1.13	1.85	6.0	5.45	485
Fox 4	3490	1280	36.7	66	180	1 3/32	1.10	1.95	6.1	5.56	476
Auburn 56	3640	1255	34.5	67	195	1 3/32—	1.10	1.94	6.7	4.87	471
Stoneville 7A	3298	1283	38.9	69	178	1 3/32—	1.11	1.77	6.1	5.45	470
DeKalb 220	3410	1220	35.8	59	165	1 3/32	1.11	1.79	6.0	4.87	456
DeKalb 108	3356	1190	35.5	60	168	1 3/32	1.14	1.91	6.4	4.54	446
Deltapine Sm. Lt.	3135	1222	39.0	73	187	1 1/16	1.15	1.99	8.2	5.20	446
Delta Queen	3291	1190	36.2	65	180	1 3/32—	1.11	1.96	6.5	4.89	442
Rex	3232	1180	36.5	59	167	1 3/32—	1.11	1.73	6.6	4.45	437
Auburn M	3287	1180	35.9	66	182	1 1/16	1.10	1.92	6.7	4.34	437
Dixie King	3227	1168	36.2	53	146	1 3/32—	1.10	1.87	5.6	4.92	434
Stardel	3162	1167	36.9	67	180	1 3/32	1.12	1.95	5.8	4.98	433
M8	2950	1183	40.1	71	178	1 3/32	1.11	2.07	7.6	4.85	433
Delfos 9169	3410	1136	33.3	61	181	1 1/8 —	1.17	1.78	7.1	4.42	432
Stoneville 3202	3182	1180	37.1	68	184	1 1/16—	1.09	1.83	7.1	4.67	431
Coker 100A	3242	1157	35.7	64	180	1 3/32—	1.12	1.88	6.6	4.93	431
Deltapine 15	2939	1173	39.9	69	175	1 3/32	1.12	2.00	7.2	5.09	429
Lankart 57	3088	1188	38.5	49	128	1 1/32	1.05	1.84	8.5	4.93	428
Empire	3198	1110	34.7	52	150	1 3/32—	1.08	1.77	6.3	4.36	416
Acala 4-42	2908	1087	37.4	55	145	1 3/32	1.09	2.33	6.3	4.80	403
Average	3240	1194	36.7								
LSD at 5% level		107									

Planted April 23; harvested September 5 and October 15. Soil: Deer Creek sandy loam

Mississippi Cotton Variety Tests For 1962

IN THE DELTA

By JAMES B. DICK and ROBERT H. LOE[1]

Cotton variety trials were conducted by the Delta Branch Experiment Station in 1962 at the following locations in the alluvial Yazoo-Mississippi Delta; the Delta Station at Stoneville, the Woolfolk Plantation near Tunica, the Heaton Plantation at Clarksdale, and the Schaeffer Plantation near Yazoo City.

The 1962 season was characterized by very good weather in April and early May which permitted early planting. Very little seedling disease was evident at the test locations. Hot, dry weather prevailed during July and August. Supplemental irrigation was used to excellent advantage where it was available. In most instances the hot weather and high light intensity produced heavy fruiting during July. In some places excessive shedding was caused by the hot, dry August, but in some areas receiving occasional showers the boll set was highly satisfactory. Harvesting began in early September and continued into October with rapid maturity and early opening of bolls.

Delta weather during September and October was excellent for harvesting in most areas. Harvesting of 95 percent of the Delta cotton crop was completed earlier than in any previous year. Yields on many plantations averaged from 700 to 1,000 pounds of lint per acre.

Quality of the 1962 Delta cotton has been excellent. Grades were lower than in 1961, due to occasional showers and excessive second growths. Laboratory tests on hundreds of bales of the 1962 crop indicates that it is among the best quality crops produced in the Mississippi Delta. Fiber length, micronaire, and fiber strength were exceptionally good.

Current strains of 16 commercial varities were used in the 1962 variety trials. The Stoneville and Tunica trials are included in a cooperative beltwide variety testing program and included Acala 4-42 and Lankart 57 as National Standard varieties. Stoneville 7A and Stoneville 213 are new varieties included in all tests.

Table 1 gives the results of the yield trial at the Delta Station. The test was planted on April 23. Emergence and survival were highly satisfactory. Supplemental irrigation was used on July 19 and August 9 during the hot, dry weather. Rapid maturity and boll opening prevented a first harvesting in time to obtain data on earliness. The first picking was made on September 5, when 74 percent of the entire yield was harvested. Yields ranged from 1,087 to 1,323 pounds of lint per acre with an overall average of 1,194 pounds.

Lint percentages were higher than usual and the micronaire indexes indicated coarser fiber than normal for the varieties. Tensile strengths and staple lengths showed these properties to be about average for the several varieties.

Table 2 gives results of the yield trial conducted on the Woolfolk Plantation 6 miles northeast of Tunica. Planting on May 8 resulted in good stands. The variety plots were irrigated once in early August. Rain followed the irrigation and provided sufficient moisture to allow an excellent fruit set, but also caused excessive second growth of foliage and delayed maturity. A first harvesting was made on September 21 when 72 percent of the cotton was harvested. Total lint yields ranged from 1,305 pounds for Stoneville 213 to 863 pounds for Lankart 57, with an overall average of 1,066 pounds. The average yield in 1960 was 1,207 pounds and in 1961, 969 pounds. Lint percentages and staple lengths were about normal. Fiber strength was slightly below normal.

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[1] Research Aronomist, Crops Research Division, Aricultural Research Service, U. S. Department of Agriculture, and Assistant Agronomist Delta Branch Experiment Station, Mississippi Agricultural Experiment Station. This report is based upon results from cooperative research conducted by the Mississippi Agricultural Experiment Station and the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.

Results of the Clarksdale test are given in table 3. The test plots were planted on April 27. Good stands were obtained, with practically no seedling disease mortality. Hot, dry weather prevailed in the test area, where irrigation was not available, causing excessive shedding of squares and small bolls during August. Lint yields averaged 746 pounds per acre. The first picking on September 13 resulted in harvesting 82 percent of the total yield and did not allow any comparison of earliness between the varieties. The excessively hot and dry conditions of late August evidently prevented full boll maturity, as lint percentages were very low and micronaire indexes indicated fine fiber in most of the varieties.

Data from the test conducted near Yazoo City are given in table 4. Early season conditions were conducive to good production. July was very dry, and the plots were irrigated on July 20. Rain in late August caused heavy second growth of foliage and some boll rot. A first picking was made on September 19 when 80 percent of the cotton was harvested. Final yields of the varieties ranged from 900 to 1,224 pounds of lint per acre. Lint percentages, staple lengths, fiber strengths and micronaire indexes were about normal for the varieties planted.

Yields of seed cotton and lint, lint percentages, money value per acre, and fiber properties of staple length, strength (T_1) and micronaire are given in tables 1 through 4 for the four variety-yield trials. Gross money value per acre was computed by adding the Commodity Credit Corporation loan value for the staple of each variety at Strict Low Middling grade and the seed value at $52.00 per ton. Varieties are listed in each table in order of dollar value per acre. This order follows closely the yields of lint per acre, with few exceptions.

Table 5 shows the average lint percentages, staple lengths, fiber strengths and micronaires for 16 varieties for the four tests. Unfortunately, seasonal conditions did not permit obtaining worthwhile data on earliness. Lint percentages are highest for Deltapine 15, Deltapine Smooth Leaf, Stoneville 7A and Stoneville 213. Most of the varieties have staple lengths of 1 1/16 to 1 3/32 inches. Delfos 9169 averaged 1 1/8 inch in staple length and Stoneville 3202 averaged 1 1/32+ inches. Fiber strength of tenacity (T_1), as determined by the stelometer at 1 1/8 inch gauge, is relative. By this measure Stardel, Fox 4, Deltapine 15, and Deltapine Smooth Leaf have stronger fiber than do the other varieties. Stoneville 3202 and Rex have relatively weak fibers. Fineness, as measured by the micronaire, ranged from 4.08 for Delfos 9169 and 4.19 for Stoneville 3202 to the coarser fibered Fox 4, Stoneville 7A, and Stoneville 213. All the varieties had higher micronaires in 1962 than in 1961 but all fall in the desirable range for mill use.

Yield data were obtained from replicated and randomized plots in each test. Other data were determined from samples taken from individual plots at first harvest. Classing was done by the Staple Cotton Cooperative Association in Greenwood, Mississippi. Fiber properties data were determined by the fiber laboratory of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, at Knoxville, Tennessee.

Tunica

Table 2.—Yield, gin turn out, staple length, strength, elongation, micronaire, and gross value per acre for the 1962 cotton variety test at Tunica, Missisipi.

	Yield per acre			Fiber Properties					Gross value
Variety	Seed cotton	Lint	Percent Lint	Staple length Classer	UHM	Strength (T_1)	Elongation (E_1)	Micro-naire	per acre (SLM)
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 213	3381	1305	38.6	1 3/32—	1.15	1.74	7.3	5.10	$479
DeKalb 108	3272	1171	35.8	1 3/32	1.15	1.73	6.2	4.59	438
Delfos 9169	3364	1124	33.4	1 1/8	1.21	1.68	6.9	4.13	429
Stoneville 7A	3046	1167	38.3	1 3/32—	1.17	1.70	5.6	4.66	429
Fox 4	3198	1135	35.5	1 3/32—	1.16	1.84	6.7	4.60	423
Delta Queen	3080	1121	36.4	1 1/8 —	1.14	1.72	6.3	4.24	419
Deltapine Sm.Lf.	2986	1141	38.2	1 1/16	1.13	1.79	8.4	4.20	418
DeKalb 220	3090	1124	36.4	1 3/32—	1.14	1.72	5.8	4.15	417
Stardel	2874	1069	37.2	1 3/32	1.16	1.85	5.5	4.54	396
Dixie King	2978	1063	35.7	1 3/32—	1.16	1.67	5.3	4.20	396
Auburn 56	3038	1048	34.5	1 3/32—	1.13	1.73	7.6	4.18	395
Stoneville 3202	2951	1071	36.3	1 1/16—	1.08	1.62	7.0	4.06	393
Coker 100A	2926	1030	35.2	1 3/32	1.20	1.70	6.1	4.50	386
Rex	2885	1016	35.2	1 3/32—	1.13	1.63	6.6	4.30	379
Auburn M	2768	963	34.8	1 3/32—	1.14	1.81	6.6	3.63	360
Deltapine 15	2548	978	38.4	1 3/32—	1.15	1.80	7.6	4.30	359
Acala 4-42	2602	971	37.3	1 1/16	1.13	1.84	5.4	4.32	357
Empire	2616	903	34.5	1 3/32—	1.15	1.74	6.2	4.08	338
Lankart 57	2357	863	36.6	1 1/32	1.10	1.63	7.7	4.74	314
Average	2945	1066	36.2						
LSD at 5% level		135							

Planted May 8; harvested September 21 and October 18. Soil: Sandy Loam

Clarksdale

Table 3.—Yield, gin turnout, staple length, strength, elongation, and gross value per acre for the 1962 cotton variety test at Clarksdale, Mississippi

	Yield per acre			Fiber Properties					Gross value
Variety	Seed cotton	Lint	Percent Lint	Staple length Classer	UHM	Strength (T_1)	Elongation (E_1)	Micro-naire	Per acre (SLM)
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 213	2542	940	37.0	1 3/32	1.11	1.95	6.1	4.69	$349
Stoneville 3202	2314	817	35.3	1 1/16	1.05	1.63	6.8	3.94	304
Auburn M	2428	779	32.1	1 1/16	1.06	1.90	6.3	3.60	295
Stoneville 7A	2137	789	36.9	1 1/32	1.11	1.77	5.8	4.43	293
DeKalb 220	2281	773	33.9	1/1/32—	1.13	1.90	5.8	3.95	291
Coker 100A	2325	763	32.8	1 3/32	1.11	1.88	6.4	3.97	290
Auburn 56	2284	758	33.2	1 3/32	1.08	1.81	6.8	3.90	288
Deltapine Sm. Lf.	2142	760	35.5	1 3/32—	1.13	1.95	7.5	4.20	283
Rex	2246	752	33.5	1 1/16	1.10	1.73	6.3	4.12	282
Fox 4	2210	751	34.0	1 1/16	1.11	2.00	5.8	4.50	281
Delta Queen	2270	740	32.6	1 3/32—	1.11	1.80	6.3	3.79	281
DeKalb 108	2237	734	32.8	1 3/32	1.10	1.87	6.8	4.07	279
Dixie King	2178	721	33.1	1 3/32—	1.10	1.94	5.4	4.22	273
Deltapine 15	1933	692	35.8	1 3/32	1.09	1.98	6.4	4.31	259
Delfos 9169	2112	672	31.8	1 1/8 —	1.14	1.84	7.1	3.70	258
Stardel	1933	680	35.2	1 3/32—	1.11	1.93	5.6	4.17	254
Empire	1750	567	32.4	1 1/16	1.08	1.86	5.5	4.10	214
Average	2195	746	34.0						
LSD at 5% level		89							

Planted April 27; harvested September 13 and October 17. Soil: Sandy loam

Yazoo City

Table 4.—Yield, gin turn out, staple length, strength, elongation, micronaire, and gross value per acre for the 1962 cotton variety test at Yazoo City, Mississippi.

	Yield per acre			Fiber Properties					Gross value
	Seed		Percent	Staple length		Strength	Elongation	Micro-	Per acre
Variety	cotton	Lint	Lint	Classer	UHM	(T_1)	(E_1)	naire	(SLM)
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 213	3131	1224	39.1	1 3/32—	1.09	1.82	6.6	4.97	$448
Stoneville 7A	2875	1144	39.8	1 1/16	1.12	1.81	5.9	5.14	416
Auburn 56	3042	1104	36.3	1 3/32	1.10	1.85	7.2	4.62	411
Deltapine Sm. Lf.	2764	1089	39.4	1 3/32	1.10	1.95	7.2	4.92	400
Deltapine 15	2611	1034	39.6	1 3/32	1.10	1.93	7.7	4.91	379
Rex	2807	1030	36.7	1 1/16—	1.09	1.70	6.7	4.51	377
Fox 4	2758	1023	37.1	1 1/16	1.12	1.87	6.7	4.95	377
Delta Queen	2715	1012	37.3	1 3/32—	1.07	1.84	7.3	4.79	374
DeKalb 220	2745	1013	36.9	1 1/16	1.10	1.86	6.2	4.54	373
Delfos 9169	2848	980	34.4	1 1/8	1.18	1.89	6.4	4.07	372
Stoneville 3202	2709	1024	37.8	1 1/32	1.06	1.80	6.0	4.10	370
Dixie King	2598	933	35.9	1 3/32	1.09	1.82	5.7	4.82	348
Coker 100A	2571	926	36.0	1 3/32	1.12	1.92	5.6	4.65	346
Empire	2540	933	36.7	1 1/16	1.08	1.87	5.6	4.60	344
Stardel	2385	918	38.5	1 3/32—	1.08	1.95	5.8	5.04	337
DeKalb 108	2535	900	35.5	1 3/32—	1.12	1.95	5.2	4.50	335
Average	2727	1018	37.3						
LSD at 5% level		124							

Planted April 20; harvested September 19 and October 24.

Soil: Sandy Loam

Delta Average

Table 5.—Average lint percent, classer's staple length, upper half mean, fiber strength, and micronaire for 16 varieties grown at four Delta locations in 1962.

Variety	Lint percent	Classer's staple length	Upper half mean	Fiber strength (T_1)	Micronaire
		inches	inches	index	index
Auburn 56	34.6	1 3/32	1.10	1.83	4.40
Coker 100A	34.9	1 3/32	1.12	1.85	4.52
Delta Queen	35.6	1 3/32	1.07	1.83	4.43
Delfos 9169	33.3	1 1/8	1.18	1.80	4.08
Deltapine 15	38.4	1 3/32	1.10	1.93	4.65
Deltapine Sm. Lf.	38.0	1 1/16+	1.10	1.92	4.63
Dixie King	35.2	1 1/16+	1.09	1.83	4.54
DeKalb 108	34.9	1 3/32	1.12	1.87	4.42
DeKalb 220	35.8	1 1/16+	1.10	1.82	4.38
Empire	34.6	1 1/16	1.08	1.81	4.29
Fox 4	35.8	1 1/16+	1.12	1.92	4.90
Rex	35.5	1 1/16	1.09	1.70	4.34
Stardel	37.0	1 3/32	1.08	1.92	4.68
Stoneville 7A	38.5	1 1/16+	1.12	1.76	4.92
Stoneville 213	38.6	1 3/32	1.09	1.84	5.05
Stoneville 3202	36.6	1 1/32+	1.06	1.72	4.19

COTTON TESTS IN HILL SECTIONS

By G. D. GREEN, R. C. ALBRITTON, R. E. COATS, S. P. CROCKETT,
B. C. HURT, B. E. WAGGONER AND L. B. WALTON

The cotton variety picture is changing rapidly as shown by the results presented in this report. Of the ten highest average yielding varieties in the 1962 tests, only two have been in the tests as long as five years. These are Auburn 56 and Stoneville 3202.

Of the 19 varieties in the test, this is the first year in the tests for three, the second year for four, the third year for two and the fourth year for two varieties.

The highest yielding variety in these tests in 1962 averaged 804 pounds of lint per acre and the lowest one averaged 643 pounds, or a difference of 161 pounds. Of the eight varieties which have been in the tests as long as five years, the highest yielding one averaged 738 pounds of lint per acre and the lowest one averaged 640 pounds for the two to five years they have been in completed tests. This is a difference of 98 pounds. See Summary Tables.

Eight tests were completed by the Hill Section Stations in 1962. One was at the Central Station, State College; one on Flatwoods and one on Pontotoc ridge soil at the Pontotoc Ridge-Flatwoods Branch Station, Pontotoc; two by the North Mississippi Branch Station, Holly Springs, one on hill land at the station and one on bottom land on the farm of Mr. C. C. Moore about four and one half miles north of Holly Springs; one on bottom land at the Northeast Mississippi Branch Station, Verona; one at the Black Belt Branch Station, Brooksville and one at the Brown Loam Branch Station, Raymond. The test at Newton was damaged so much by drouth that it was not harvested for record since it was felt that the yields would not fairly represent the yielding potential of the varieties.

Yields were good in most of the tests. The stand was practically perfect in the State College test and generally satisfactory at the other locations. Standard corrections were made for skips, only the excess over three feet per skip being counted. The stand in two replications at Verona was so badly broken by flooding that they were not harvested for record. Insect control was generally satisfactory.

The weather was dry at State College and southward. Rainfall was quite variable north of State College. May was dry, June wet, July dry at Pontotoc and Verona and wet at Holly Springs. August was dry at these locations but Holly Springs suffered a wet spell of three weeks beginning the last week in August.

19 Varieties In All Tests

Nineteen varieties were common in all the tests. Nine additional entries, five of them unreleased breeders strains, were included at State College. Of these additional entries, Auburn M was released by the Missouri Station in 1962 and Acala 4-42, Lankart 57 and Coker 100A were included as part of a beltwide test.

All seed were furnished by the breeders or their representatives except that Acala 4-42, Coker 100A, Deltapine 15 and Lankart 57 for State College as National Entries in the beltwide test were supplied by the Delta Branch Experiment Station, Stoneville, Mississippi. The nineteen varieties common to all the tests and Auburn M are commercial varieties and seed should be on the market. Empire 61A and Empire 61B are closely related and seed of Empire will possibly be sold as Empire WR61 which was released in 1961 to replace Empire WR. Seed were planted in the same condition as received. They were all delinted and treated in some manner.

Summary Tables

Summary Table Showing Average Yields in Hill Station Tests for two to five years in pounds of lint per acre for years indicated

	State	Brooks	New-	Ray-	Pontotoc		Holly Springs		Ver-	
Variety	College 58-62	ville 59-62	ton 58-61	mond 60 & 62	Flatwods 59-62	Ridge 58-62	Hill 58-62	Bottom 61&62	ona 59&62	Aver-age.
Stoneville 3202	629	781	443	550	618	735	797	996	1091	738
Auburn 56	648	753	484	562	632	764	822	962	935	729
Dixie King	634	728	448	474	623	739	751	868	1037	700
Deltapine Sm. Lf.	634	756	439	559	584	715	739	857	969	695
Rex	657	732	509	552	633	785	709	784	882	694
Plains	637	762	450	515	571	701	753	810	967	685
Delfos 9169	643	700	380	548	536	617	730	841	968	652
Deltapine 15	588	689	390	555	493	652	681	779	936	640

Summary Table Showing Average Yields in Hill Station Tests for 1962 in Pounds of Lint per Acre

	State	Pontotoc		Holly Springs			Brooks-	Ray-	Aver-
Variety	College	Flatwoods	Ridge	Hill	Bottom	Perona	ville	mond	age
Stoneville 213	839	526	695	766	937	966	1002	698	804
Stoneville 7A	830	494	639	713	774	946	1026	692	764
DeKalb 220	795	487	681	723	864	848	1008	698	763
Carolina Queen	840	528	700	677	800	900	999	587	754
Auburn 56	866	535	648	785	811	736	902	650	742
DeKalb 108	826	527	667	639	809	825	900	617	726
Stoneville 3202	754	513	553	694	838	927	944	568	724
Delta Queen	893	492	564	682	718	883	984	566	723
Empire 61B	821	538	695	612	700	825	862	645	712
Coker 100A	789	470	578	726	792	810	961	511	705
Fox 4	829	504	662	596	587	924	888	592	698
Empire 61A	817	543	667	566	647	919	842	576	697
Deltapine Sm. Lf	824	436	593	503	743	878	1055	543	697
Rex	804	515	619	626	704	829	837	619	694
Dixie King	830	512	590	633	753	912	859	406	687
Plains	733	433	550	644	657	902	908	540	671
Delfos 9169	749	449	574	669	672	807	905	451	660
All In One	751	528	566	586	636	845	801	442	644
Deltapine 15	727	353	516	515	730	835	974	496	643

Coastal Plain

Cotton Variety Averages, Coastal Plain Branch Station, Newton

	Yield per acre, pounds lint						Averages			
Variety	1957	1958	1959	1960	1961	Ave.	Dollar val. per a., SLM	Lint %	Staple 32nds. inch	Bolls per lb lint
Auburn 56	508	270	623	545	496	489	171	36.9	33.3	189
Dixie King	487	220	589	549	432	455	158	38.3	33.5	152
Plains	476	246	541	515	496	455	158	37.7	33.2	176
Stoneville 3202	485	212	585	516	459	451	155	39.3	32.7	197
Deltapine Sm. Lf.	398	204	586	492	472	431	150	39.8	33.7	199
Empire	496	221	498	446	392	411	143	37.7	33.3	153
Deltapine 15	401	165	521	519	353	392	134	39.7	33.1	198
Delfos 9169	405	127	528	502	364	385	137	36.6	34.9	184
Rex	----	295	589	590	560	----	----	----	----	----
Stoneville 7	461	180	590	560	----	----	----	----	----	----
Pope	540	250	537	560	----	----	----	----	----	----
Coker 100A	----	----	566	502	441	----	----	----	----	----
Fox 4	----	----	543	493	451	----	----	----	----	----
DeKalb 108	----	----	----	535	473	----	----	----	----	----
All-In-One	----	----	----	467	419	----	----	----	----	----

State College

Cotton Varieties, Central Station, State College, 1962.

Variety	Yield per A., lbs. Seed cotton	Lint	Dollar Val. per A., SLM	Lint pct.	Staple 32nds. inch	Bolls per pound Seed cotton	Lint	Pct. first picking	Fiber strength, 1,000 lbs. sq. inch	Fiber fineness, micronaire units
Delta Queen	2227	893	322	40.1	34.3	65	163	79	98	4.9
Auburn 56	2255	866	310	38.4	33.7	65	170	81	89	4.9
Carolina Queen	2032	840	301	41.3	34.0	66	160	77	96	5.4
Stoneville 213	2004	839	300	41.8	34.0	70	168	79	97	5.6
Rex SLL60-38	2091	834	297	39.9	33.7	65	165	86	95	4.9
Stoneville 7A	1978	830	297	41.9	34.7	70	168	74	97	5.5
Dixie King	2086	830	300	39.7	34.3	53	134	81	101	5.1
Fox 4	2079	829	299	39.8	34.3	68	172	79	94	5.9
DeKalb 108	2104	826	299	39.2	34.3	60	155	76	96	4.8
Deltapine Sm. Lf.	1977	824	298	41.6	35.0	73	176	76	92	5.6
Empire 61B	2058	821	296	39.9	34.4	54	136	89	95	4.7
Empire 61A	2053	817	295	39.8	34.0	55	140	88	100	4.4
Rex	1981	804	280	40.5	32.7	62	154	86	96	4.5
DeKalb 220	2011	795	287	39.5	34.3	61	156	76	96	4.8
Coker 100A	1969	789	285	40.0	34.3	66	165	74	95	5.0
Stoneville 11	1935	784	278	40.5	33.7	65	162	77	95	5.2
DeKalb 220-21-23-2	1945	784	282	40.3	34.3	61	151	82	101	5.0
Auburn M	1962	760	272	38.7	33.0	66	172	87	102	4.3
Deltapine 5540M	1850	756	272	40.8	34.3	67	165	76	100	4.3
Stoneville 3202	1861	754	268	40.5	33.3	70	173	80	89	5.0
All In One	1968	751	269	38.2	33.7	58	152	80	97	4.9
Delfos 9169	2036	749	276	36.8	35.7	60	163	66	88	4.4
Coker 100A, N. Std.	1865	739	267	39.6	34.3	64	162	72	102	5.1
Plains	1839	733	261	39.8	33.3	66	165	73	96	4.9
Deltapine 15	1691	727	255	43.0	33.3	72	168	77	92	5.3
Acala 4-42	1730	709	251	41.0	33.7	**54**	**131**	**84**	**105**	**4.8**
Stoneville KP	1866	676	245	36.2	33.7	65	180	79	98	4.9
Lankart 57	1575	665	230	42.2	32.0	48	113	79	88	5.4
LSD @ 5%	156	—	—	—						
CV	—	6.990	—	—						

Soil: Verona Fine Sandy Loam
Planted April 24
Poisoned 13 times
Fertilizer: 72-48-48

Cotton Variety Averages, Central Station, State College

	Yield per acre, pounds lint						Averages			
Variety	1958	1959	1960	1961	1962	Average	Dollar val. per a., SLM	Lint %	Staple 32nds. inch	Bolls per lb lint
Rex	430	717	751	584	804	657	233	37.8	33.9	166
Auburn 56	399	700	713	561	866	648	233	35.9	34.2	187
Delfos 9169	352	778	853	485	749	643	235	35.5	35.6	169
Plains	409	702	746	597	733	637	227	37.3	33.9	169
Deltapine Sm.Lf.	441	635	772	499	824	634	227	39.1	34.9	186
Dixie King	404	688	756	490	830	634	227	37.5	34.3	147
Stoneville 3202	405	685	741	562	754	629	223	38.6	33.8	184
Deltapine 15	412	613	675	512	727	588	209	39.9	34.5	182
Coker 100A	----	755	748	559	789	----	----	----	----	----
Fox 4	----	634	700	535	829	----	----	----	----	----
DeKalb 108	----	----	748	576	826	----	----	----	----	----
All In One	----	----	699	566	751	----	----	----	----	----
Acala 4-42	----	----	792	530	709	----	----	----	----	----
Lankart 57	----	----	695	320	665	----	----	----	----	----
Delta Queen	----	----	----	547	893	----	----	----	----	----
Stoneville 7A	----	----	----	549	830	----	----	----	----	----
Stoneville 213	----	----	----	502	839	----	----	----	----	----
DeKalb 220	----	----	----	533	795	----	----	----	----	----

Seed and planting plans were furnished from Central Station where the 100 boll samples and data were processed. Branch station personnel took care of all details associated with producing and harvesting the crop at their respective stations.

Tests were planted in randomized complete blocks. Six replications were planted in all tests except Holly Springs where eight were used. Only four were harvested for record at Verona. Plots were single rows which ranged from 40 to 185 feet long and 36 to 42 inches wide.

Brown Loam

Cotton Varieties, Brown Loam Branch Station, Raymond, 1962

	Yield per a., lbs.					Bolls per lb.		
Variety	Seed cotton	Lint	Dollar val. per A. SLM	Lint pct.	Staple 32nds inch	seed cotton	Lint	Pct. first picking
DeKalb 220	1730.	698.	239.	40.3	31.7	76.	189	91.
Stoneville 213	1670.	698.	242.	41.7	32.0	82.	197.	90.
Stoneville 7A	1644.	692.	240.	42.1	32.0	86.	204.	84.
Auburn 56	1696.	650.	225.	38.3	31.3	81.	211.	90.
Empire 61B	1637.	645.	222.	39.4	31.3	68.	173.	90.
Rex	1554.	619.	217.	39.8	32.0	75.	188.	95.
DeKalb 108	1583.	617.	213.	38.9	31.7	73.	187.	87.
Fox 4	1487.	592.	204.	39.8	31.3	85.	215.	94.
Carolina Queen	1421.	587.	201.	41.3	31.0	76.	185.	87.
Empire 61A	1451.	576.	202.	39.6	32.0	64.	162.	90.
Stoneville 3202	1370.	568.	191.	41.4	30.3	83.	201.	89.
Delta Queen	1414.	566.	198.	40.0	32.0	80.	199.	91.
Deltapine Sm. Lf.	1333.	543.	189.	40.7	32.0	84.	208.	90.
Plains	1384.	540.	189.	39.0	32.7	72.	185.	79.
Coker 100A	1297.	511.	179.	39.4	32.3	80.	204.	91.
Deltapine 15	1189.	496.	169.	41.7	31.7	84.	203.	80.
Delfos 9169	1173.	451.	161.	38.4	33.0	68.	179.	74.
All In One	1149.	442.	155.	38.4	32.0	72.	187.	90
Dixie King	1062.	406.	143.	38.2	32.0	61.	161.	69.
LSD @ 5%	302	123	Fertilizer: 117-84-84					
CV		18.4%	Planted May 4					
Soil: Richland			Poisoned 9 times					

Cotton Variety Averages, Brown Loam Branch Station, Raymond

	Yield per acre, pounds lint						Averages			
Variety	1955	1956	1957	1960	1962	Average	Dollar val. per a., SLM	Lint %	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	759	497	983	474	650	673	243	36.3	33.3	207
Deltapine 15	816	403	735	614	496	613	217	39.8	33.3	205
Stoneville 3202	736	461	729	532	568	605	206	39.4	31.3	206
Plains	781	502	694	489	540	601	213	37.6	32.9	193
Dixie King	714	552	735	541	406	590	209	37.6	33.1	161
Delfos 9169	745	415	599	465	451	535	196	36.8	34.3	193
Deltapine Sm.Lf.	-----	-----	869	575	543	-----	-----	-----	-----	-----
DeKalb 108	-----	-----	-----	517	617	-----	-----	-----	-----	-----
Rex	-----	-----	-----	484	619	-----	-----	-----	-----	-----
Fox 4	-----	-----	-----	449	592	-----	-----	-----	-----	-----
Coker 100A	-----	-----	-----	490	511	-----	-----	-----	-----	-----
All In One	-----	-----	-----	391	442	-----	-----	-----	-----	-----

Northeast Mississippi

Cotton Variety Averages, Northeast Mississippi Branch Station, Verona.

	Yield per a., lbs. lint			Averages			
Variety	1959	1962	Aver-age	Dollar val. per a, SLM	Lint per-cent	Staple 32nds. inch	Bolls per lb. lint
Stoneville 3202	1255	927	1091	384	39.0	34.1	187
Dixie King	1162	912	1037	371	37.8	35.1	146
Coker 100A	1156	810	983	352	38.0	35.6	181
Fox 4	1037	924	981	349	38.4	34.8	173
Deltapine Sm. Lf.	1059	878	969	343	40.7	35.0	183
Delfos 9169	1129	807	968	351	36.5	36.5	170
Plains	1032	902	967	335	37.9	35.0	164
Deltapine 15	1036	835	936	331	40.5	35.0	175
Auburn 56	1164	736	935	339	36.7	34.8	189
Rex	934	829	882	315	38.1	35.3	168

Cotton Varieties, Northeast Mississippi Branch Station, Verona, 1962

	Yield per a., lbs.		Dollar		Staple	Bolls per. lb	
Variety	Seed cotton	Lint	val per. A. SLM	Lint pct.	32nds inch	seed cotton	Lint
Stoneville 213	2457	966	353	39.3	35.0	71	181
Stoneville 7A	2396	946	345	39.5	35.0	72	183
Stoneville 3202	2409	927	337	38.5	34.0	75	195
Fox 4	2444	924	337	37.8	34.7	67	176
Empire 61A	2526	919	340	36.4	35.3	56	155
Dixie King	2452	912	336	37.2	35.3	57	154
Plains	2374	902	309	38.0	34.3	66	173
Carolina Queen	2278	900	328	39.5	35.7	66	167
Delta Queen	2330	883	325	37.9	35.7	63	167
Deltapine Sm. Lf.	2169	878	319	40.5	35.0	77	190
DeKalb 220	2256	848	312	37.6	35.7	67	177
All In One	2335	845	313	36.2	35.3	62	171
Deltapine 15	2078	835	304	40.2	35.0	68	170
Rex	2252	829	306	36.8	35.0	65	176
DeKalb 108	2291	825	306	36.0	35.7	64	179
Empire 61B	2243	825	305	36.8	35.3	57	154
Coker 100A	2143	810	300	37.8	36.0	72	189
Delfos 9169	2287	807	303	35.3	36.7	62	176
Auburn 56	2056	736	271	35.8	34.7	74	206
LSD @ 5%		111	Fertilizer: 78-108-72				
CV% 9.0%			Planted: May 2				
Soil: Iuka Silt Loam			Poisoned 7 times				

One hundred boll samples were picked from each variety in three replications at each location. Lint percentage, boll size, staple length and other fiber properties were determined from these samples. Only well developed bolls were carefully picked soon after opening for these samples. Consequently the characteristics determined from them are only relative between the varieties in the test and should be used only to compare these varieties. These things vary greatly with soil, season, cleanliness of harvesting, etc.

The staple lengths reported are averages of the determinations of three pro-

Pontotoc

Cotton Variety Averages, Pontotoc Ridge, Pontotoc Station.

Variety	Yield per acre, pounds lint						Averages			
	1958	1959	1960	1961	1962	Average	Dollar val. per a./SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Rex	763	931	645	969	619	785	264	38.6	34.3	161
Auburn 56	717	878	566	1010	648	764	263	37.2	34.2	179
Dixie King	707	892	549	959	590	739	255	38.2	34.4	146
Stoneville 3202	737	798	603	986	553	735	249	39.2	33.3	188
Deltapine Sm. Lf.	737	746	569	928	593	715	249	40.1	34.5	187
Plains	749	743	542	922	550	701	252	37.6	34.3	170
Deltapine 15	607	644	558	935	516	652	226	39.9	33.9	188
Delfos 9169	581	738	449	742	574	617	218	36.7	35.2	175
Coker 100A	—	946	534	1066	578	—	—	—	—	—
Fox 4	—	751	547	1050	662	—	—	—	—	—
DeKalb 108	—	—	530	1014	667	—	—	—	—	—
All In One	—	—	508	860	566	—	—	—	—	—
DeKalb 220	—	—	—	994	681	—	—	—	—	—
Stoneville 7A	—	—	—	1007	639	—	—	—	—	—
Delta Queen	—	—	—	968	564	—	—	—	—	—

Cotton Varieties, Pontotoc Ridge, Pontotoc Station, 1962

Variety	Yield per a., lbs. Seed cotton	Lint	Dollar val per. A. SLM	Lint pct.	Staple 32nds inch	Bolls per. lb. seed cotton	Lint
Carolina Queen	1805.	700.	250.	38.7	33.3	79.	205
Empire 61B	1892	695	251.	36.7	33.3	64.	175
Stoneville 213	1807	695	249.	38.4	33.7	85	223
DeKalb 220	1859	681	250	36.6	34.3	77	212
Empire 61A	1820.	667	241.	36.7	33.3	64	176.
DeKalb 108	1848.	667	245	36.1	34.3	76	210
Fox 4	1782.	662.	242	37.1	34.0	80	216
Auburn 56	1837.	648.	239.	35.2	34.7	80	226
Stoneville 7A	1640.	639.	231	38.9	34.3	84	218
Rex	1679.	619.	223.	36.8	33.7	76	206
Deltapine Sm. Lf	1580.	593.	216	37.5	34.3	87	233
Dixie King	1651.	590	217	35.7	34.3	66	185
Coker 100A	1559.	578.	208.	37.0	33.7	80	215
Delfos 9169	1668.	574.	216.	34.4	36.7	77.	226.
All In One	1578.	566.	208.	35.8	34.0	73	204
Delta Queen	1539.	564	207	36.6	34.7	79	216
Stoneville 3202	1557.	553	201	35.5	33.3	90	255
Plains	1540	550.	202	35.7	34.3	75	210
Deltapine 15	1404.	516.	189	36.7	34.7	91	247
LSD @ 5%	257	95	Fertilizer: 85-52-52				
CV		13.2%	Planted April 24				
Soil: Atwood			Poisoned 9 times				

Cotton Variety Averages, Flatwoods, Pontotoc Station.

	Yield per acre, pounds lint					Averages			
Variety	1959	1960	1961	1962	Average	Dollar val. per a./SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Rex	710	530	777	515	633	224	39.9	33.3	166
Auburn 56	734	491	766	535	632	226	37.6	33.5	191
Dixie King	735	505	738	512	623	222	38.9	33.4	151
Coker 100A	686	466	853	470	619	221	38.9	33.8	187
Stoneville 3202	694	448	818	513	618	214	40.4	32.4	197
Deltapine Sm. Lf.	683	495	721	436	584	204	40.6	33.1	199
Fox 4	661	458	663	504	572	204	38.3	33.2	199
Plains	732	441	678	433	571	204	38.4	33.8	181
Delfos 9169	659	408	627	449	536	196	37.1	34.7	179
Deltapine 15	585	396	639	353	493	176	40.4	33.7	197
DeKalb 108	—	499	790	527	—	—	—	—	—
All In One	—	435	659	528	—	—	—	—	—
Delta Queen	—	—	786	492	—	—	—	—	—
DeKalb 220	—	—	784	487	—	—	—	—	—
Stoneville 7A	—	—	701	494	—	—	—	—	—

Cotton Varieties, Flatwoods, Pontotoc Station, 1962

	Yield per a., lbs.		Dollar		Staple	Bolls per. lb	
Variety	Seed cotton	Lint	val per. A. SLM	Lint pct.	32nds inch	seed cotton	Lint
Empire 61A	1392.	543.	191	39.0	32.7	63	161
Empire 61B	1378.	538.	192.	39.0	33.0	64	164
Auburn 56	1452	535.	196.	36.8	34.0	76	207
All In One	1325.	528	188.	39.9	33.7	67.	170
Carolina Queen	1337.	528.	191.	39.4	34.0	75	192
DeKalb 108	1402.	527	192.	37.6	34.7	74	198
Stoneville 213	1374.	526.	191.	38.3	34.0	87	228
Rex	1344.	515	182.	38.3	32.7	71	187
Stoneville 3202	1296.	513	177.	39.6	31.7	90	227
Dixie King	1328.	512.	180.	38.5	32.3	63	165
Fox 4	1377	504.	182.	36.6	33.3	83	227
Stoneville 7A	1239.	494.	176.	39.9	33.3	85	214
Delta Queen	1303.	492.	179.	37.7	34.3	78	208
DeKalb 220	1323.	487.	178.	36.8	34.7	75	205
Coker 100A	1252	470.	171.	37.5	34.0	78.	210
Delfos 9169	1236.	449.	165.	36.3	34.3	73	202
Deltapine Sm. Lf	1086.	436.	152.	40.1	32.3	90.	224.
Plains	1141	433	158.	38.0	34.0	76.	200
Deltapine 15	903.	353.	128.	39.1	34.7	86.	220
LSD @ 5%	242	91					
CV		16.3%					

Soil: Bude; Fertilizer: 85-52-52; Planted May 10; Poisoned 9 times

fessional cotton classers each representing a different organization and stapling samples from a different replication. Fiber strength and fineness for the State College test were determined by a commercial testing firm. The value per acre is the value of lint and seed. Seed were figured at $49 per ton and lint at the loan price for Strict Low Middling of the staple length of that variety in that particular test. Two pickings were made in the State College, Holly Springs and Raymond tests. The percent picked at the first was calculated as an indication of earliness. Calculations of the 1962 data, except the statistical analyses, were performed on a computing machine and the figures were rounded for simplicity.

Most varieties in the tests are good. Planters may select a good variety, by a study of the averages tables from the station with conditions nearest like his own plus consideration of the latest results for newer varieties. Summary tables showing average lint yields for all locations combined for 1962 and recent years are included to give an overall picture of the performance of the respective varieties at all hill section test locations. From these summary tables, it may be seen that Stoneville 213 led in 1962 and that Stoneville 3202 and Auburn 56 produced the highest yields on the average.

Use of a wilt resistant variety is very important on soils heavily infected with this disease. Of the commercial varieties in the 1962 tests, All-In-One, Auburn 56, Auburn M, Carolina Queen, Coker 100A, DeKalb 108, Delta Queen, Dixie King, Empire 61A, Empire 61B, Plains and Rex are resistant to Fusarium wilt which is the most common type. No variety in the tests is resistant to Verticillium wilt which is sometimes bad in certain localities. Coker 100A and Delta

North Mississippi

Cotton Variety Averages, Bottom Land, North Mississippi Branch Station, Holly Springs.

	Yield per acre, pounds lint			Dollar val. per	Lint	Staple 32nds.	Bolls per lb.
Variety	1961	1962	Average	a./SLM	percent	inch	lint
Stoneville 3202	1153	838	996	361	37.7	33.6	177
DeKalb 220	1102	864	983	379	36.3	35.5	168
DeKalb 108	1116	809	963	356	35.8	35.0	164
Auburn 56	1113	811	962	354	36.4	34.8	177
Coker 100A	1124	792	958	354	36.8	35.7	176
Delta Queen	1044	718	881	327	36.2	35.6	183
Dixie King	983	753	868	323	35.7	35.3	153
Stoneville 7A	954	774	864	317	37.7	35.0	183
Deltapine Sm. Lf	970	743	857	315	37.3	35.1	192
Delfos 9169	1010	672	841	316	34.0	36.0	173
Plains	962	657	810	299	35.7	34.5	171
Fox 4	983	587	785	291	35.6	34.8	190
Rex	864	704	784	291	35.8	35.3	170
Deltapine 15	828	730	779	284	38.3	34.8	181
All In One	852	636	744	277	34.6	34.8	163

Cotton Varieties, Bottom Land, North Mississippi Branch Station, Holly Springs, 1962

	Yield per a., lbs.		Dollar		Staple	Bolls per lb.		Pct.
Variety	Seed cotton	Lint	val. per A. SLM	Lint pct.	32nds inch	seed cotton	Lint	first picking
Stoneville 213	2383.	937.	339.	39.3	34.3	76.	194.	93.
DeKalb 220	2341	864.	316.	36.8	34.7	67	182	96.
Stoneville 3202	2208.	838.	301.	37.9	33.3	73	193.	95.
Auburn 56	2256	811.	298.	35.9	34.3	67	188	93.
DeKalb 108	2240	809.	297.	36.1	34.3	65.	181.	92
Carolina Queen	2105.	800.	287.	38.0	33.7	75.	197.	91
Coker 100A	2130	792.	292.	37.1	35.7	68.	184.	92.
Stoneville 7A	1989.	774.	281.	38.9	34.3	75.	193.	88.
Dixie King	2085.	753.	277.	36.1	34.3	59.	165.	93.
Deltapine Sm. Lf.	1987.	743.	271.	37.3	34.3	75.	200.	93.
Deltapine 15	1862.	730.	264.	39.2	34.3	75.	192.	92.
Delta Queen	1971.	718.	265.	36.4	35.0	70.	193.	93.
Rex	1941.	704.	258.	36.3	34.0	66.	184.	94.
Empire 61B	1940.	700.	257.	36.0	34.7	57.	159.	95.
Delfos 9169	1967.	672.	251.	34.1	35.3	62.	182.	93.
Plains	1823.	657.	241.	36.0	34.0	65.	181.	89.
Empire 61A	1838	647	239.	35.2	34.7	58.	167.	93.
All In One	1786	636.	234.	35.6	34.0	62.	174.	90.
Fox 4	1621.	587.	215.	36.2	34.0	71.	198.	87.
LSD @ 5%	315	115						
CV		15.7%						

Soil: Probably Collins

Fertilizer: 72-48-48
Planted April 28
Poisoned 15 times

Cotton Variety Averages, Hill Land, North Mississippi Branch Station, Holly Springs.

Variety	Yield per acre, pounds lint 1958	1959	1960	1961	1962	Average	Dollar val. per a./SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	828	853	779	867	785	822	294	37.4	34.1	191
Stoneville 3202	897	858	711	827	694	797	272	39.4	32.5	199
Plains	811	781	742	786	644	753	266	38.0	33.8	180
Dixie King	761	779	811	771	633	751	268	37.6	33.9	157
Deltapine Sm. Lf.	849	771	713	858	503	739	259	40.1	33.8	196
Delfos 9169	743	707	747	786	669	730	266	36.7	35.2	182
Rex	658	756	742	764	626	709	252	38.5	33.8	175
Deltapine 15	831	717	685	655	515	681	238	39.9	33.7	195
Coker 100A	—	784	755	811	726	—	—	—	—	—
Fox 4	—	831	694	743	596	—	—	—	—	—
DeKalb 108	—	—	803	805	639	—	—	—	—	—
All In One	—	—	706	723	586	—	—	—	—	—
Stoneville 7A	—	—	—	827	713	—	—	—	—	—
DeKalb 220	—	—	—	813	723	—	—	—	—	—
Delta Queen	—	—	—	831	682	—	—	—	—	—

Cotton Varieties, Hill Land, North Mississippi Branch Station, Holly Springs, 1962

Variety	Yield per a., lbs. Seed cotton	Lint	Dollar val. per A. SLM	Lint pct.	Staple 32nds inch	Bolls per lb. seed cotton	Lint	Pct. first picking
Auburn 56	2280.	785.	291.	34.4	34.7	75.	218.	91.
Stoneville 213	1966.	766.	277.	38.9	34.0	78.	201.	90.
Coker 100A	2009.	726.	269.	36.1	35.0	73.	203.	88.
DeKalb 220	1981	723.	261.	36.5	33.3	69.	189.	91.
Stoneville 7A	1900	713.	257.	37.5	33.3	79.	211.	90.
Stoneville 3202	1911.	694.	247.	36.3	32.7	79.	219.	93
Delta Queen	1924.	682	253.	35.4	35.0	76.	214.	90.
Carolina Queen	1830.	677.	248.	37.0	34.3	74.	202.	89.
Delfos 9169	2030.	669.	256.	32.9	37.0	70.	214.	85.
Plains	1837.	644.	238.	35.0	34.3	70.	202.	89.
DeKalb 108	1831.	639.	236.	34.9	34.3	68.	197.	90.
Dixie King	1925.	633.	237.	32.8	34.3	60.	184.	88.
Rex	1744.	626.	230.	35.8	34.0	67.	187.	87.
Empire 61B	1718.	612.	222.	35.6	33.7	60.	168.	92.
Fox 4	1669.	596.	216.	35.7	33.7	78.	218.	91.
All In One	1797.	586.	217.	32.6	33.3	68.	209.	91.
Empire 61A	1583.	566.	205.	35.7	33.3	59.	167.	93
Deltapine 15	1384.	515.	185.	37.2	33.0	83.	225.	90.
Deltapine Sm. Lf.	1381.	503.	182.	36.4	33.7	84.	232.	88.
LSD @ 5%	232	82	Fertilizer: 72-48-48					
CV		12.8%	Planted April 30					
Soil: Grenada Silt Loam			Poisoned: 18 times					

Queen are described as tolerant to Verticillium wilt.

The crop was early. Lint percentage was high at State College, Brooksville and Raymond and generally low at Pontotoc, Holly Springs and Verona. Staple length was about average at State College, Pontotoc, Holly Springs and Brooksville and a little short at Raymond. Bolls were larger than average at State College and Raymond and smaller than average at the other locations. Fiber strength and fineness were only checked for the Central Station test at State College. Strength was some 15 to 20 percent higher than is usually reported for most of these varieties. However, the crop for the State as a whole was stronger than average in 1962. Fibers were of about average fineness to slightly coarser than average. Seventy five to 80 thousand pounds per square inch is considered

Black Belt

Cotton Variety Averages, Black Belt Branch Station, Brooksville.

	Yield per acre, pounds lint					Averages			
Variety	1959	1960	1961	1962	Average	Dollar val. per a./SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Stoneville 3202	845	577	756	944	781	270	39.6	33.1	215
Plains	854	577	710	908	762	269	38.0	34.1	194
Deltapine Sm. Lf	778	590	600	1055	756	266	40.7	34.4	214
Auburn 56	817	582	709	902	753	266	37.5	33.8	212
Coker 100A	717	616	710	961	751	268	38.5	34.7	206
Rex	784	675	632	837	732	258	38.9	34.3	184
Dixie King	836	611	606	859	728	258	38.3	34.4	167
Fox 4	728	590	630	888	709	250	38.9	34.1	212
Delfos 9169	694	615	585	905	700	255	36.0	35.5	203
Deltapine 15	750	564	468	974	689	242	40.6	34.5	215
DeKalb 108	—	631	799	900	—	—	—	—	—
All In One	—	536	554	801	—	—	—	—	—
DeKalb 220	—	—	745	1008	—	—	—	—	—
Delta Queen	—	—	653	984	—	—	—	—	—
Stoneville 7A	—	—	588	1026	—	—	—	—	—

Cotton Varieties, Black Belt Branch Station, Brooksville, 1962

	Yield per a., lbs.		Dollar		Staple	Bolls per. lb.	
Variety	Seed cotton	Lint	val per. A. SLM	Lint pct.	32nds inch	seed cotton	Lint
Deltapine Sm. Lf.	2491	1055	377	42.3	34.7	84	198
Stoneville 7A	2439	1026	367	42.0	34.3	77	184
DeKalb 220	2557	1008	365	39.4	34.7	71	181
Stoneville 213	2393	1002	359	41.8	34.7	83	199
Carolina Queen	2459	999	360	40.6	34.0	73	180
Delta Queen	2495	984	356	39.4	34.3	78	198
Deltapine 15	2283	974	348	42.6	34.3	83	195
Coker 100A	2443	961	351	39.3	35.0	78	198
Stoneville 3202	2308	944	335	40.8	33.7	87	214
Plains	2323	908	329	39.1	34.3	72	184
Delfos 9169	2468	905	335	36.6	35.7	69	189
Auburn 56	2364	902	328	38.1	34.0	79	209
DeKalb 108	2355	900	328	38.2	34.3	69	180
Fox 4	2250	888	321	39.4	34.3	80	203
Empire 61B	2204	862	308	39.0	33.7	62	160
Dixie King	2201	859	312	39.0	34.3	60	153
Empire 61A	2189	842	306	38.4	34.0	61	161
Rex	2143	837	304	39.0	34.7	70	181
All In One	2147	801	293	37.2	34.0	68	183
LSD @ 5%	176	69					
CV		6.5%					

Soil: Houston Clay; Planted April 17; Fertilizer: 100-60-40; Poisoned 6 times

average strength. Average fineness is 4.0 to 4.9 micronaire units. A higher reading indicates coarser fibers.

Yield and other data are shown in the accompanying tables. LSD @ 5% means that the odds are 19 to 1 that a difference of less than the amount shown cannot be considered a real difference in that test. CV means coefficient of variation and the smaller it is the better the test. Blank spaces in the averages tables means that the variety was not in the test that year or the full number of years.

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Factors Related to the

Use Of Credit Resources By Farm Families

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FACTORS RELATED TO THE USE OF CREDIT RESOURCES BY FARM FAMILIES

By DOROTHY DICKINS

Introduction

Recent studies in the Home Economics Department have shown that many Mississippi farm families make use of credit. More data are needed about use of such resources by farm families.

It is the purpose of this report to study (1) ways in which families who are making a career of farming use consumption, production, and real estate credit; and (2) factors related to the use of these three forms of credit. The definition of families making a career of farming is the definition of a "farm family" used in a credit study made in Iowa and Missouri.[1] With such a definition it is possible not only to compare the use of credit by the Mississippi farm family with that of the Iowa-Missouri farm family, but also to predict use of credit by Mississippi families in the future. With smaller and smaller numbers of youth going into farming and farms getting larger, there will be in the future relatively more career farm families in Mississippi like those in Iowa-Missouri.

Scope And Methods

Included in this study were 150 white families, 30 from each of five counties in Mississippi. A soils specialist in the Mississippi Agricultural Experiment Station was consulted for names of counties which would represent principal soil types in the State. The following counties were selected: Calhoun, Jefferson, Lamar, Leake, and Leflore.

To be eligible for this study, the family must have contained both husband and wife who had been married at least one year and had operated a farm the past year (1960); must have derived last year at least one-half their cash income from farming; and who are this year (1961) operating 30 acres of land or more.

Dr. Earl E. Houseman, Director, Statistical Standards Division, Agricultural Marketing Service, U. S. Department of Agriculture, drew the areas in which the interviewing was to be done in such a way that a representative sample of families in each county were visited. In only 162 (9 percent) of the dwellings shown on the maps were there eligible families. In 52 percent of the dwellings listed on the Iowa-Missouri maps there were eligible families. This means there are six times more of these types of families in Iowa-Missouri than in Mississippi.[2]

Fewer families were eligible in Lamar and Leake Counties, 6 and 7 percent respectively. More families were eligible in Calhoun County—21 percent. The main reason for ineligibility in Lamar and Leake Counties was that the family had not derived at least one-half of their cash income from farming the past year. Many in these counties had off-farm work in Hattiesburg and Jackson.

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[1] The methods and techniques of this study closely follow a study being made in Iowa and Missouri which is part of the Northcentral Regional Project, NC-32. The eligibility requirements used in this study are the same as those used in the Iowa-Missouri study. There were no Negro families in their study; therefore, being a member of the white race was made an eligibility requirement of this study. Other reasons for excluding Negro families were that use of credit and sources chosen by Negro families are different from those by white families.

Interviews with the use of schedules were completed with both husband and wife in 150 of the 162 eligible families during the spring of 1961. Data were not completed from 12 eligible families. Homemakers and farm operators in several of these families could not be contacted. Others were uncooperative or had serious sickness in the home during the period the study was made.

Description of Families

Three kinds of information were obtained that help to describe the families included. These are family characteristics, background of husband and wife, and size and kind of farm operation.

Family Characteristics: An understanding of the characteristics of the families studied is needed in order to evaluate the findings of this study. Families were classified into the following types:

Type of family	Percent
No children at home	39
All children under 14 years	23
Children 6-18	13
Children 14 and over	17
Children of miscellaneous ages	8

In one-third of the families the husband and wife had been married thirty years or more; only one-fifth had been married less than fifteen years. The sample, in other words, contained many older people.

Ages of husbands and wives of families were:

	Age of farm operator	Age of homemaker
	Percent	Percent
Under 39 years	13	23
40 - 54 years	46	51
55 or over	41	26

Thirty percent of the families had 5 or more members; forty percent had 3 or 4 members; and thirty percent had 2 members.

Homemakers in these families had more schooling than their husbands. Fifty-one percent of the wives had finished high school or attended college; only 40 percent of the husbands had this much schooling. At the time that most of these people were of school age there was more economic pressure to keep the boy rather than the girl at home.

Background of Husband and Wife: Husbands and wives were asked three questions which gave information about their background. These concerned how their parents would feel about using credit for family and farm; such as, for an auto, refrigerator, or livestock; where they had lived during different periods of their life (whether on farm, in open country, village, town, etc.); and what off-farm jobs they had held.

As will be noted (Table 1), parents were more favorable toward use of producer than consumer credit. They were more favorable towards real estate than producer credit.

One would most certainly classify these farm-operators and their wives as farm

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[2] Families in the Iowa study were drawn from the following 19 counties in Southcentral Iowa: Adair, Adams, Appanoose, Clarke, Davis, Decatur, Guthrie, Jefferson, Lucas, Madison, Marion, Monroe, Ringgold, Taylor, Union, Van Buren, Wapello, Warren, and Wayne. Families in the Missouri study were drawn from the following 32 counties in Northcentral Missouri: Adair, Audrain, Boone, Caldwell, Callaway, Chariton, Clark, Daviess, DeKalb, Gentry, Grundy, Harrison, Howard, Knox, Lewis, Lincoln, Linn, Livingston, Macon, Marion, Mercer, Monroe, Montgomery, Pike, Putnam, Ralls, Randolph, Schuyler, Scotland, Shelby, Sullivan and Worth. Counties in these two states were similar in social, economic and demographic characteristics; also in soils. The soils were glacial and wind blown soils. They would be medium to high in fertility according to Mississippi standards. According to Missouri standards they would be medium or average in fertility. According to Iowa standards they would be lower than average in fertility. Records were obtained from 114 Missouri and 89 Iowa families.

Table 1.—Percentage of parents of husbands and wives who would favor use of credit for specified items.

Item	Parents of husband favoring credit in buying	Parents of wife favoring credit in buying
	Percent	Percent
Automobile	30	32
Refrigerator	37	39
Television	23	29
Furniture	33	35
New farm machinery and equipment	48	52
Feed	44	49
Cattle	43	45
Farm real estate	61	59

oriented (Table 2). The great majority of both groups had spent most of their lives on a farm. But somewhat more wives than husbands had lived at various periods of their lives in areas other than the farm.

Thirty-three percent of the farm operators and 39 percent of their wives had never had work off the farm. Of those who had had off-farm work, the most common kinds for men were semi-skilled and unskilled wage work, skilled wage work, and white collar work (such as clerical service, salesmen). Eleven of the 150 men mentioned work for another farmer, such as custom work, farm manager. The most common kinds for women were semi-skilled and unskilled wage work (usually factory work), clerical work and professional service.

In Table 3 is shown average number of days farm operator and his wife worked off the farm and their average earnings from such work. In ten of these families both husband and wife had had off-farm work during 1960. However, in five of these families this off-farm work was in connection with a business owned by them, usually a small grocery store. Days worked by operators and homemakers in the other five families were much below average.

About one-fourth of the farm operators and one-fifth of the wives had had some off-farm work during 1960. This low proportion is related to the fact that one of the eligibility requirements of the study was that at least half of their cash income must have come from farming. This eligibility requirement excluded a number of families, especially those near the larger city who more often had off-farm work which offered more cash than could be derived from the farm. However, in this study there were several large planters who also had a very remunerative type of work off the farm such as selling insurance, practicing law, operating a non-farm business, farm custom work,

Table 2.—Percentage of farm operators and wives who had lived on a farm during different periods of their lives.

Period	Farm operator**	Wife
	Percent	Percent
Pre-school years	93	83
Grade school years	91	81
High school years	92	80
Young adult years	83	77
At time of marriage*	89	
Since marriage	94	94

*Obtained from husband only.

**Two men gave no information

Table 3.—Days worked and earnings of those with off-farm work during 1960 and during January 1961 to date of interview (Spring 1961) and days they expected to work and earnings from date of interview to December 31, 1961.

Off-farm work*	Farm operators	Wives
No. working during 1960	37	28
Av. days worked by those working, 1960	109	196
Av. amount earned by those earning, 1960	$2591	$1696
No. working Jan. 1961 to date of interview	20	24
Av. days worked by those working Jan. 1961 to date of interview	51	92
Av. amount earned by those working Jan. 1961 to date of interview	$727	$633
No. who expect to work from date of interview to Dec. 31, 1961	24	23
Av. days expect to work from date of interview to Dec. 31, 1961	80	216
Av. amount expect to earn from date of interview to Dec. 31, 1961	$2306	$1395

*Average days and average earnings based on averages of those giving information. A few who said they worked replied, "Don't know", to questions about number days and earnings.

etc. To be noted is the fact that even in this group of career farmers there seems to be an upward trend in off-farm employment. Days worked and earnings in 1960 were less than those expected in 1961.

Size and Kind of Farm Operation; Attitude Towards Farming: Very few farm tenants were eligible for this study since one eligibility requirement was that they were operating 30 acres or more of land. (In 1954 tenants in Mississippi had an average of 19 acres of land in farms). Sixty percent of the families in this study owned all the land they operated; 35 percent owned part and rented part; and 5 percent were full tenants.

The number of acres operated by the 150 farm families ranged from 30 to 2400. Thirty-six percent operated less than 75 acres; 37 percent operated 75-249 acres; and 27 percent operated 250 acres or more.

Every family was asked about the main source of income from their farm. As will be noted from the following summary, the general farm was the most typical.

Type of farm	Percent
General	47
Livestock	25
Cotton	19
Other	9

Farms were classified as general when the value of products from one source or group of sources did not represent as much as 50 percent of the total value of all farm products sold. Livestock and cotton farms were those in which 50 percent or more of the total value of all farm products sold were livestock (cattle, calves, hogs, sheep, goats, wool) or cotton. Other farms included dairy farms, poultry farms, and farms selling sweet potato slips.

Farm operators were asked to give an estimate of the value of what they owned. Estimates of current values, that is, what these items were worth to the family, were requested. Total assets of the 150 families ranged from $3248 to $657,700. Thirty-two percent reported values under $25,000; 38 percent, values of $25,000-$74,999; and 30 percent, values of $75,000 and over.

Information was obtained also on net worth of the family. By net worth is meant total assets minus liabilities, or financial obligations, at the beginning of the year. The net worth of the families included ranged from $879 to $615,700. The net worth of 35 percent of the families was under $25,000; of 30 percent, $25,000-$59,999; and of 35 percent, $60,000 and over.

At the time of the interview, spring 1961, 19 percent of the families were participating in programs of the Farmers Home Administration; 7 percent in the Balanced Farm and Home Program of the Mississippi Agricultural Extension Service; and 2 percent in both of these.

Families were asked three questions which would throw light on their attitude towards farming. These were (1) the considerations that had kept them on the farm, (2) whether they had seriously considered changing their occupation, and (3) whether they expected to move in the next five years.

As will be noted in Table 4, financial reimbursement was of minor consideration in remaining on the farm. The fact that farming was a "liked" (for many, a "loved") occupation was most often mentioned. The question might well be raised here whether or not this is the real reason for remaining on the farm. The fact is that these were above average farm operators. Practically all owned land. They had much invested in their farms. They were a part of community life. Eighty-seven percent were 40 years or over. When the interviewer asked them what kept them on the farm it sounded better to say, "I like farming", than to say, "I make a good profit farming" or "It's all the work I know". About one-third did state, however, that farming was the only work they knew. About one in 14 mentioned economic return. It is not considered good taste to discuss one's favorable economic situation.

Only six men reported that they had seriously considered changing their occupation. Reasons given were money situation; farm so small, can do better off farm; think can make more off the farm; couldn't get sufficient labor; to be near things; to be in town near kin.

When asked if they expected to move in the next 5 years, 142 of the 150 reported "No"; five said, "Don't know"; and three answered, "Yes". Those who replied "Don't know" were tenants and reported the owner might sell the farm or rent to another. Only one of the five answering "Don't know" would seek nonfarm work if he should leave the present farm. Two of the three stating they would move in the next 5 years would seek off-farm work. The other, a sharecropper, would not. He stated, "A sharecropper gets a better deal moving." This means that in the next five years only 3 of the 150 think they will get out of farming.

One might briefly characterize the group of farmers included in this study as a very satisfied lot. One factor may be the fact that most of them owned farm land.

Family Goals

Fourteen cards, each containing a family goal, were laid out in a random manner before the homemaker. The interviewer read aloud the goal on each card as she laid it down. She asked the homemaker to select four goals her family was working especially hard to accomplish. These we will call long-run goals. After the homemaker had selected four cards, the remaining ten cards were again laid out in a random manner and the homemaker was asked to select four goals to which her family was also giving special attention at the present time. These we will call short-run or current goals.

Before completing questions concerning the two types of family goals, the homemakers were asked to tell the interviewer about special goals their families were

Table 4.—Considerations that have kept the families on the farm.

Considerations	Percent
Satisfied; love farming; like farm life; best in satisfaction	50
Always farmed; only occupation I know; all work I know; couldn't get anything else to do; hard to change occupation	31
Have made a good living; have proved successful; make fair living; do better to stay on farm	7
My mother owned this farm; I was born here; this is my home; my duty to stay here	4
All children like farm; have several children to help; want to raise boys on farm; best place to rear family	4
Other: Trained in Agriculture; graduate of MSU; my own boss	4

working on which were not on the cards. Only 31 women mentioned goals not on cards. Nineteen mentioned a new home; five wanted to travel, such as to go to Europe; and two wanted to help married children. Five other goals were mentioned by one woman each and included such things as better health; to have own auto.

Long-run goals most often mentioned by homemakers were to increase total production on the farm and to increase savings accounts (Table 5). Short-run goals most often mentioned were to improve the yard and exterior appearance of the house; to add to or improve farm building and/or fix farm equipment, such as fences, feeding floors; and to take part in community affairs and organizations.

Twice as many women reported increasing savings account and reducing their indebtedness as long-run goals as mentioned these as short-run or current goals . On the other hand more than twice as many mentioned taking part in community affairs and organizations and promoting recreational activities of each family member or the family group as short-run than long-run goals. This may reflect the recent emphasis of the Mississippi Agricultural Extension Service on programs of community development and family recreation.

Relationships were studied of goals to age and education of the homemaker, net worth, farm tenure, socio-economic rating of the family, and willingness to assume debt.

More significant relationships were found between long-run goals of the family and age of homemaker than between long-run goals and other factors examined. More younger than older women mentioned expanding size of farm enterprise, reducing their indebtedness or getting out of debt, and providing for special education of their children (See Table 1 in Appendix).

More women with less education and from families of lower net worth mentioned gaining and/or maintaining respect of her neighbors and other community members as a long-run goal than did those with more education and from families of higher net worth. More part than full owners mentioned reducing indebtedness or getting out of debt. More families with lower than higher socio-economic rating mentioned as a long-run goal improving the house itself or adding water system, kitchen cabinets. However, socio-economic rating score was largely based on the house and its equipment and a relationship would be expected.

Age of homemaker was also an important factor in short-run or current goals (See Table II in Appendix). More older than younger women mentioned no short-run goals. More younger than older mentioned adding to moveable furnishings or household equipment and providing for special education of children, including college.

Replies that they had no short-run goals were more often made by women with elementary schooling only and by women with college training than by women with high school training; and by women in families of higher socio-economic rating, higher net worth, and less willingness to assume debt than by those with lower socio-economic rating, lower net worth, and more willingness to assume debt. (See Table II in Appendix).

Socio-Economic Rating

In construction of the socio-economic scale we tried out 33 items. These included construction of house; rooms per person; type of living room; plumbing; meetings attended past month by husband and wife; number of magazines subscrib-

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[3] "Trace Line Analysis, An Improved Method of Item Analysis," James H. Copp, Pennsylvania State University. (Paper read at the annual meeting of the Rural Sociological Society, August 25-27, 1960.) Copp shows on page 15 that if less than 20% or more than 80% of the total sample endorse an item, it will not scale when subjected to item analysis.

Table 5.—Percentages* of homemakers naming specified goals on which family is working.

Goals	Long-run goals	Short-run or current goals
	Percent	Percent
Increase total production on farm	48	28
Improve the yard and exterior appearance of the house	40	36
Improve farm land	40	32
Increase our savings account	48	24
Add to or improve farm building and/or fixed farm equipment as fences, feeding floors	28	36
Provide for special education of our children such as music lessons, nurses training, college	36	20
Take part in community affairs and organizations	16	36
Reduce our indebtedness or get out of debt	36	12
Add to moveable home furnishing or household equipment	20	28
Improve house or add such things as plumbing, kitchen cabinets	24	24
Gain and/or maintain the respect of my neighbors and other community members	24	24
Expand size of the farm enterprise (including further capital investment possibly)	16	28
Promote recreational activities of each family member or family group	8	20
Own our farm, or add to amount of land or other real estate we own.	8	12
None	8	40

*Adds up to 400 percent since homemakers gave 4 goals for each question.

ed to; last grade completed by husband and wife; equipment owned by family. Items had by less than twenty percent or more than 80% of the total sample of families having were omitted.[3] This left a scale including 18 items. (See Appendix B, page 32.)

Total socio-economic scores of families using this scale ranged from 0 - 54. One family scored 0 and two scored 54. Socio-economic scores were distributed as follows:

Socio-economic score	No. of families
0-30	48
31-40	55
41-54	47

Willingness to Assume Debt

Each interviewee was given 10 cards with a statement of opinion which some people have about credit. They were asked to read carefully each statement and tell the extent to which they agreed or disagreed with the statement. The statements were as follows:

(1) Most farm families would do well to hold off buying modern equipment for their homes until they can pay cash for it.

(2) Every farm family must own its own farm in order to get ahead financially.

(3) Most farm families profit by using production credit.

(4) Young farm families should get out of debt as soon as possible.

(5) The only way that some families will get major improvements in their houses is to borrow.

(6) It is better for a family to borrow a sizeable amount in order to buy a large farm than to buy a smaller farm and be less in debt.

(7) Farm families would do well to wait until they have accumulated their own money rather than borrow money for farm production purposes.

(8) Most farm families who have small livestock enterprises free of debt make more money than those who enlarge their enterprises by borrowing.

(9) It is better to rent a farm than to go in debt to buy land.

(10) A farm operator who is short of capital often would profit by borrowing

more money before paying off the debts he already has.

An analysis was made to determine consistency of replies to statements.[4] This method involved calculating scores for each individual family on each statement, and correlating the scores for each statement with the total scores. Statements were then plotted to observe direction. If a statement correlated significantly with the total score it was retained providing expected direction was observed.

The following statements were retained for use in getting scores for willingness to assume debt: (1), (4), (6), (7), (8), (9) and (10).[5]

Five responses were possible for each statement according to the degree of agreement or disagreement. Weights from zero to four were assigned, with higher numbers representing a greater predisposition towads assuming debts.

Total scores using this scale ranged from 0-27. One family made a score of 0, another a score of 27. Scores for willingness to assume debt were distributed as follows:

Willingness to Assume Debt Score	**Number Families**
13 & under	50
14 - 19	53
20 and over	47

"Low" included those families with scores of 0 to 14 points; "middle" included scores of 14 - 19 points; and "high" included those with 20-27 points.

Table 3 in the Appendix gives opinions of homemakers regarding the seven statements concerning credit. The majority of homemakers agreed either definitely or somewhat with statements 1, 4, 6, and 10; and the majority of homemakers disagreed either definitely or somewhat with statements 7, 8, and 9.

The majority of homemakers agreed that most farm families would do well to hold off buying modern equipment for their home until they could pay cash (statement 1); that young farm families should get out of debt as soon as possible (statement 4); that it is better for a family to borrow a sizeable amount in order to buy a large farm than to buy a smaller farm and be less in debt (statement 6); and that a farm operator short of capital often would profit by borrowing more money before paying off the debts he already has (statement 10).

The main reasons given for agreeing with statement 1 (relating to not buying modern household equipment until you can pay cash) were: (1) Prefer cash basis; don't like to go into debt; and (2) Essentials come first, farm equipment more important. There was a greater acceptance of production credit than consumer credit in the sample.

The main reasons for agreeing with statement 4 (relating to young farm families getting out of debt as soon as possible) were: (1) To work towards other goals such as buy land, savings account, college for children, old age security, freedom from worry; and (2) It's good management to be out of debt, interest is high, could lose investment.

The main reasons given for agreeing with statement 6 (relating to borrowing more and buying a larger farm) were: (1) There's more profit in a big farm, it takes money to make money; and (2) Have to have large farm to buy and use modern equipment; big farm is a necessity these days.

Main reasons given for agreeing with statement 10 (relating to borrowing more money before paying off debts) were: (1) Must borrow to produce; takes money to make money; the larger the yield, the

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[4] Ibid page 9 footnote[3]

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[5] Family goal (b) one of the goals about which the family was questioned, reduce our indebtedness or get out of debt, was added as the eleventh item. However, this item did not correlate significantly with total scores.

more money for paying off debts; and (2) If he does the job he should; depends on family; if he's moderate and doesn't borrow too much.

The majority of homemakers disagreed that farm families would do well to wait until they have accumulated their own money rather than borrow money for farm production purposes (statement 7); that most farm families who have small livestock enterprises free of debt, make more money than those who enlarge their enterprises by borrowing (statement 8), and that it is better to rent a farm than to go in debt to buy land (statement 9).

The main reasons given for disagreeing with statement 7 (relating to saving money rather than borrowing for farm production purposes) were: (1) Have to borrow to carry out good production practices; can't accumulate enough and can't wait; would never have anything if we waited; and (2) Can be making large profits while paying debts; more profit.

Main reasons for disagreeing with statement 8 (relating to money made by those with small scale livestock enterprises) were (1) Large enterprises make more profit; more volume, larger income; and (2) Depends on farmer and his family and how they manage.

The main reasons for disagreeing with statement 9 (stating it is better to rent than go into debt to buy land) were: (1) Rent payments would soon pay for the farm; rental could be applied to debt; and (2) Have something to work for (independence, pride; why give to the other fellow; best to work for self.

In replies of these homemakers one finds full realization of the need for large scale farm production and use of credit under certain conditions. Many are aware of the misuse of credit and often warn about carrying it too far, and introduce hedging statements, such as "if he does the job he should," "if he's a moderate," and "depends on the family."

Use of Credit — Six Hypothetical Situations

Each homemaker and each farm operator was told, "We are going to talk about 6 situations that might occur in a farm family. Each is pictured by a drawing and a statement." Respondents were interviewed separately.

The respondent was given a sheet depicting the first situation. After reading the statement and studying the picture, he was asked how he would probably use the $500. After he responded he was given a sheet depicting the second situation, etc.

The six situations were as follows:

1. Assume that you had as two of your family goals (a) to reduce your moderate farm mortgage indebtedness and (b) to buy modern laundry equipment for your home. If, after taking care of your expenses of farm operation and family living for the year and after paying the regular installment due on your farm mortgage loan, you had a balance on hand of $500, how would you probably use it? (Circle Response)

	Don't know		
(a) Pay extra installment on mortgage	0	$200	$500
(b) Buy automatic washer and dryer	$500	$300	0

2. Assume that you own a 200 acre farm and have just completed paying off the mortgage on it. You had just about decided to realize a long-time goal of remodeling your farm house, but suppose that 40 acres adjoining your present farm came on the market at what you consider a favorable price. In either case, it would be necessary to borrow some of the money and give a mortgage on your present farm as security. If you could borrow $1,000 for either purpose, how would you probably use it?

		Don't know	
(a) Toward purchase of 40 acres	0	$500	$1000
(b) Toward remodeling the house	$1000	$500	0

3. Assume that you had an opportunity to borrow $300 from one of your relatives at a reasonable rate of interest with no agreement as to how it was to be used and no due date. You had as two of your goals: (a) to reduce the moderate mortgage indebtedness on your farm and (b) to increase yields by increased use of commercial fertilizer. How would you use the $300 probably?

		Don't know	
(a) Make payment on farm mortgage indebtedness	0	$150	$300
(b) Buy fertilizer	$300	$150	0

4. Suppose that you had as two of your goals to obtain labor-saving farm equipment and to install a bathroom in your house. The labor-saving farm equipment you want could cost at least $1000 and so would the bathroom. If you were able to obtain a cash loan of $1000 on favorable terms, how would you probably use it?

		Don't know	
(a) Toward buying the farm equipment	0	$500	$1000
(b) Toward installing bathroom	$1000	$500	0

5. Suppose that your family wished to add to your line of farm machinery to make work easier, but also wanted to add counter work space and storage cabinets in the kitchen. Assume that it would take approximately the same amount of money to buy the machinery you have in mind or to add the counter space and cabinets. In either case, it would be neccessary to borrow about $1,000. Which choice would you probably make?

		Don't know	
(a) Toward purchase of farm machinery	0	$500	$1000
(b) Toward adding counter space and kitchen cabinets	$1000	$500	0

6. Suppose that, at the end of the year, after paying all the regular farm operating and family living expenses, you had a balance of $500 in cash. Two of your goals have been: (a) to own your farm free of debt and (b) to get a pickup truck. You have already paid off at least half of the mortgage indebtedness on your farm. How would you probably use the $500?

		Don't know	
(a) Make an additional payment on farm mortgage indebtedness	0	$250	$500
(b) Use toward purchase of pickup truck	$500	$250	0

Table IV in the Appendix gives a summary of the replies checked by homemakers and farm operators. Regarding the use of money, these two agreed most closely on situations six and three. Both of these situations involved a choice in use of money between farm production and farm mortgage.

The two members differed most in how they would use money in situations (5), (4), and (2). These situaitons all involved expenditures for the family versus for farm production or farm real estate. The homemaker was more favorable toward using the money for the family while the farm operator favored using it for farm production or farm real estate.

That there was not a great difference in choices of homemakers and farm operators in situation 1 is no doubt related to the home equipment listed; i.e. the automatic dryer. Due to climate, dryers are not owned to any extent by Mississippi farm families. When a dryer is occasionally needed the family can use a self-help laundry in town for a nominal price.

As will be noted in Table 6, only two (1 percent) of the husbands and wives disagreed on the use of credit in all six situations, while 38 (25 percent) agreed on the use of credit in all six situations. The surprising thing about this test is not the disagreement, but the agreement.

More than two-thirds agreed on the use of credit in four or more of the six situations.

Total Use of Credit

About three-fourths of the families (76.0 percent) had some type of credit outstanding in the spring of 1961.[6] The average debt for those using credit was $11,441, with a range from $40 to $167,200.

Production credit was being used by nearly two-thirds of the 150 families (64.7 percent). The average production debt, for those using this type of credit, was $6,223, with a range from $50 to $78,200. Fewer families (39.3 percent) had real estate debts at the time of interviewing in 1961; for these, the average debt was $11,323 with a range from $200 to $89,000 Still fewer families (30 percent) had consumer credit outstanding. Of those with consumer debt, the average amount outstanding in the spring of 1961 was $721, with a range from $17 to $4,000.

Twenty-three families (15.3 percent) were using all three kinds of credit. In these cases the average debt was $15,313, of which $8,759 was real estate credit, $5,730 was for production purposes, and $824 was consumer debt.

Forty-one families (27.3 percent) were using two types of credit. Of these 26 had production and real estate debts, the average amount being $25,625 of which $10,148 was production credit and $15,477 was real estate debt. Fourteen families had consumer and production credit outstanding, while one family was using both real estate and consumer debt.

Fifty families (33.3 percent) were using only one type of credit. Production credit alone was used by more families than any other type of credit. Thirty-four families (22.7 percent) were using only production credit. Nine families (6.0 percent) had only real estate credit outstanding while 7 families (4.7 percent) were using consumer credit only.

Use and Source of Consumer Credit

In the spring of 1961, the average amount owed by the 45 families (30 percent) using consumer credit was $721.[7] This was more than the average debt of $657[8] owed January 1, 1960, when only

Table 6.—Number and percentage of situations on use of credit in which farm operator and homemaker agree.

Agreement	No.	Percent
Agree on none	2	1.3
Agree on 1	4	2.7
Agree on 2	18	12.0
Agree on 3	23	15.3
Agree on 4	29	19.3
Agree on 5	36	24.0
Agree on 6	38	25.3
Total	150	100.0

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[6] The 95 percent confidence interval was 67-81 percent. That is, unless the sample is so rare that it would occur only one time in 20, this interval would include the true percentage of families in the type of sample that were using credit.

[7] The 95 percent confidence interval was $622-$820.

[8] The 95 percent confidence interval was $516-$798.

18 families (12 percent) were using consumer credit. From this it appears that more farm families were using consumer credit in the spring of 1961 than approximately 16 months earlier. Also, the average debt is larger. It would seem therefore, that the use of consumer credit is increasing.

Homemakers were interviewed concerning use, source, and amount of consumer credit outstanding. Information pertaining to production and real estate credit was obtained by interviews with farm operators. The families included were using consumer credit to purchase an automobile more often than for any other purpose (Table 7). Twelve percent were using consumer credit for this purpose. An automobile requires a larger outlay than many other consumption items and, therefore, it is more difficult to accumulate enough funds to buy with cash. In addition, credit is easily available for automobile purchase.

Washing machines were the next most frequent use of consumer credit. As shown in Table 7, eleven families (7.3 percent) were using consumer credit for this purpose. A number of families have shifted or are now shifting from use of hired help for laundering to doing this work themselves (with modern equipment). This fact probably accounts for more families purchasing this particular household equipment.

Six families (4.0 percent) were using consumer credit for doctor and hospital bills. A number of families mentioned using insurance to finance such expenditures. Insurance is, of course, the opposite of credit, one pays for before, rather than after receiving the goods or service. Dollars paid and dollars received are not necessarily equal for any one individual in insurance.

Refrigerators ranked next to washing machines in household equipment bought with the use of credit. Consumer credit was being used by four families for "other" purposes, such as food freezers, clothing, a boat.

Finance companies (such as GMAC, CIT) and dealers were the sources from which credit was obtained most frequently to purchase automobiles. Most automobile dealers use these finance companies. Finance companies are also used for certain household equipment.

The bank and individual were the sources of credit used for doctor and hospital bills. "Other" sources of consumer credit included the FHA (used for financing the remodeling of the house) and the Staple Cotton Cooperative Association (for financing general family living expenses).

Table 7.—Uses and sources of consumer credit owed by 45 farm families in Mississippi owing consumer credit at the time of the interview, Spring 1961.

		Sources of consumer credit (No.)				
Uses	No. families who owed*	Dealer	Bank	Finance Co.	Individual	Other
Automobile	18	4	3	10	1	--
Washing machine	11	10	--	1	--	--
Doctor, hospital bills	6	--	4	--	2	--
Refrigerator	5	4	1	--	--	--
Television	4	2	--	2	--	--
Remodeling house	4	1	1	--	1	1
Family living (general)	4	--	2	--	1	1
Kitchen range	3	2	--	1	--	--
Furniture	3	3	--	--	--	--
Plumbing system	1	--	1	--	--	--
Other	4	3	1	--	--	--

*Some families owed for more than one use.

Homemakers were asked if they had ever used credit to buy an automobile, refrigerator, television, set of furniture; and if so, where they had obtained it and why they borrowed where they did. Reasons given were as follows:

Reasons	**Percent of total reasons**
Convenience	80
Cheaper	11
Like dealer, banker, friend	4
Always used this source; do borrowing here	3
Other	2

Convenience was the most important reason for credit from dealer, finance company, bank. However, a number mentioned lower cost in connection with the bank.

Every homemaker was asked the following question: If you and your husband decided you wanted credit to buy a home freezer, an extra bedroom, an automobile, or an emergency hospital and doctor bill, where would you get the extra credit? Table 8 gives a summary of the replies. As will be noted, sources were somewhat different from those given in Table 7 of families using for specified purposes. However, in Table 7 are included only families using credit at the time of the interview. Table 8 includes replies from all families.

Consumer Credit and Related Factors

The factors studied in relation to consumer credit were: acres of land operated; willingness to assume debt; age of homemaker; education of homemaker; family composition; socio-economic rating of family; net worth of family; number sources of credit with which homemaker is familiar; number sources of credit for which correct interest rates were given.

Significant relationships were found in use of consumer credit and age of homemaker, and in use of consumer credit and number of sources of credit with which homemaker is familiar. The relationship in use of consumer credit and family composition approached the 5 percent level of significance (See Tables V, VI, and VII in Appendix).

Families with homemakers 55 years and over less often had consumer credit outstanding than families with younger homemakers. Families with no children (usually older families) less often had consumer credit outstanding. The family with children, all 13 years and under, most often had consumer credit outstanding.

Younger married people are at a stage where financial demands are greatest. Also, at this period financial needs for the farm business are also great and savings usually limited. Therefore, it might be expected that younger families would turn to credit to obtain goods and services needed for home and family.

It was found that better acquaintance with credit sources lead to greater use of consumer credit (See Table VII in Appendix). Families in which 17 percent of the

Table 8.—Where homemaker and husband would go to get credit (if decided wanted some) to purchase a home freezer, an extra bedroom, an automobile, and an emergency hospital and doctor bill.

	Where would go: Percent							
Purpose	Wouldn't use at all	Dealer	Bank	Finance Co.	Individual	Farm credit agency	Other	Total No. families
Home freezer	1	48	43	2	3	2	1	150
Extra bedroom	5	2	67	--	9	16	1	150
Automobile	3	23	52	19	1	1	1	150
Emergency hospital or doctor bills	1	3*	78	15	--	--	3	150

*Hospital

homemakers knew only 1 or 2 sources of credit and those in which 47 percent knew 4 or 5 sources had consumer credit outstanding.

Knowledge of Sources and Interest Rates

The majority (37 percent) of homemakers were familiar with 3 sources of consumer credit. The percentages were as follows:

No. sources with which familiar	Percent homemakers
1	4
2	32
3	37
4 or 5	27

Relationships between number of sources of credit with which homemakers were familiar and age and education of homemakers, farm tenure, willingness to assume debt, and net worth of the family were studied.

No significant relationships in these factors and the number of sources of credit named by homemakers were found. However, the relationship in number of sources named and age of homemaker approached the 5 percent level of significance. (See Table VIII in Appendix). Thirty-seven percent of the homemakers under 40 years, and 13 percent 55 years and over were familiar with 4 or 5 sources of consumer credit.

Homemakers were asked about interest rates at places where they were using credit, and also where **else** they could have borrowed and at what interest rate. Data were compiled of interest rates charged in communities in which the study was made (See Appendix C). Even though this list was carefully checked there may be variations from rates actually charged. It was thought important, however, to have some measure, even though rough, of the homemaker's and the farm operator's knowledge about amount of interest charges.

Relationships were studied of homemaker's knowledge of interest charges to her age and education; to willingness to assume debt; to amount of consumer credit owed; and to net worth of family. Highly significant differences (at 1% level) were found in homemaker's knowledge of interest rates and her schooling; also, significant differences in her knowledge of interest rates and in both willingness to assume debt and family net worth[9] (See Tables IX, X and XI in Appendix).

Sixty-five of the 150 homemakers reported correctly the interest rates charged by two sources of consumer credit. Forty-two women reported rates correctly from three or more sources. Forty-three reported rates correctly from one source or could give no correct rates.

Use and Source of Production Credit

In the spring of 1961, production credit was being used by 97 of the 150 families (64.7 percent); among those using this type of credit, the average amount used was $6,223. Amount of production credit among the 97 families was distributed as follows:

Production credit	No. families
$1500 and under	32
$1501 - $4500	34
$4501 and over	31

Production credit was used most frequently for "general operating" expenses (Table 9). This may be explained partially by the farmers' practice of borrowing a lump sum which is used for many different purposes. In a number of instances the interviewee could not specify the amounts of credit used for particular purposes.

New machinery and equipment was the next most frequent purpose for which production credit was obtained. Such purchases require large outlays making it necessary for many families to use borrowed funds.

Production credit was used rather frequently for the purchase of livestock followed, in order named, by fertilizer and lime; seed; gas and oil.

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[9] Significant at the 5% level.

Table 9.—Uses and sources of production credit owed by 97 farm families in Mississippi owing production credit at the time of the interview, Spring 1961.

		Sources of Production Credit (No.)					
Uses	No. families who owed*	Bank	Dealer or Merchant	PCA	FHA	Individual	Other**
General operating	65	19	--	26	15	4	1
New machinery and equipment	39	13	22	--	2	--	1
Livestock	12	--	--	--	8	4	--
Fertilizer, lime	9	2	2	1	1	--	3
Seed	8	3	1	1	--	--	3
Gas and oil	5	--	5	--	--	--	--
Buildings, repairs and improvements	5	2	--	--	2	1	--
Feed	3	--	1	--	--	1	1
Machinery and equipment repair	2	--	2	--	--	--	--
Other	1	--	1	--	--	--	--

*Some families owed for more than one use.

**Such as a farmers' cooperative, insurance company, milk condensery.

Most important sources of production credit were banks, dealers, PCA, and FHA in the order named (Table 9). PCA was used by more families to finance general operating expenses; the dealer or merchant, to finance new machinery and equipment. FHA was used by more to purchase livestock.

Farm operators were asked if they had ever used credit to purchase new machines and equipment; feed; livestock, etc.; and, if so, where they had obtained it and why they borrowed where they did.

Reasons given were as follows:

Reasons	Percent of total reasons
Convenience	56
Cheaper, long terms	34
Like dealer, banker, friend	3
Always used this source; do borrowing here	5
Other	2

Convenience was the most important reason given for use of a source by farm operators. However, more operators mentioned cost (cheaper, long terms) than did homemakers in connection with consumer credit.

Every farm operator was asked the following question: If your family wanted credit to buy a farm; seed, corn, or fertilizer; combine or hay baler; cattle, pigs, or lambs; and, tractor, fuel, and other supplies, where would you get the extra credit? Table 10 gives a summary of the replies. The bank was named by more farm operators in connection with four of the five types of items. The farm operator would most often get credit from the dealer or merchant for the combine or hay baler.

Production Credit and Related Factors

Several factors could influence the

Table 10.—Where farm operator would go to get credit (if decided they wanted some) to purchase a farm, seed corn or fertilizer, combine or hay baler, cattle, pigs, or lambs, and tractor fuel and other supplies..

	Where would go: Percent							Total
Purpose	Bank	FHA	PCA	Individual	Dealer merchant	Other*	D.K. or no reply	No. families
Farm	30	24	--	3	--	40	3	150
Seed corn; fertilizer	40	16	16	5	8	13	2	150
Combine; hay baler	34	9	6	3	42	2	4	150
Cattle, pigs, lambs	51	24	13	5	1	3	3	150
Tractor fuel & other supplies	40	12	11	5	27	3	2	150

*Such as Federal Land Bank; G. I. loan; farmers' cooperative.

use of farm production credit. An understanding of which family and economic factors are associated with the use or non-use of production credit would be helpful to educators, lenders, and others. This study considered production credit in relation to size of farm (in acres); assets; number of years farmed; farm tenure; net worth; willingness to assume debt; age and education of farm operator.

Farm size in acres and assets of the family might be expected to influence the amount of money borrowed. In addition, the number of years farmed, since it reflects stage in farm cycle, might be an influence upon the use or non-use of credit. To investigate the relationship of these factors with the use of production credit regression analysis was used. According to these tests size of farm and total assets had a significant association on the use farm families made of production credit. However, the association between use of production credit and number of years farmed was not significant[10]. A farmer with years of experience should own more of his working capital and hence need less credit.

As shown before, all except eight families in this study owned all or part of their farm. This means there were too few cases on which to compare tenants versus owners. However, a chi square test of difference in full and part owners revealed a significant association between tenure and use of production credit[11]. Part owners used it much more frequently than owners.

Also, part owners used larger amounts than full owners. Thirty percent of the full owners used more than $1500 production credit, while 67 percent of the part owners used this much. The association in amount of production credit used and tenure was highly significant (See Table XII in Appendix). A person renting is using credit and hence his attitude is likely to be more favorable toward the use of credit.

No relation was found between having or not having production debts outstanding and net worth. There was, however, a highly significant difference in amount of debts outstanding and net worth (Table XIII in Appendix). Families with high net worth used relatively large amounts of credit. Lending is usually on the basis of collateral.

A larger proportion of families with greater willingness to assume debt used production credit and used it in greater amounts than those with less willingness to assume debt. (See Table XIV in Appendix). No relationship was found between use of consumer credit and willingness to assume debt. The index of willingness to assume debt reflects the attitude of the farm wife's perception of how willing her family is to take on debt—farm, real estate, and consumer. Only one of the seven statements used, however, referred directly to consumer debt. This may mean that the index is a better measure of attitude of production and real estate debt than of consumer debt.

Farm families headed by younger men might be expected to use production credit and use it in larger amounts than families headed by older men, since younger families often are becoming established in farming at the same time they are having heavy demands for family living expenses. In addition, since they usually do not have as much savings

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[10] The dependent variable Y, was the amount of production credit used; X_1 was the size of the farm in acres; X_2 was the value of assets; and X_3 was the number of years farmed. The regression equation was: $Y = -1680.4 + 6.44243 X_1 + .04937 X_2 + 17.82774 X_3$. A test of significance of the partial regression coefficients using Student's t distribution revealed regression of X_1 on Y and X_2 on Y were both significant at the one percent level. However, the partial regression coefficient of X_3 was not significant. Overall correlation was significant at the one percent level ($R = .777$).

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[11] Significant at the one percent level.

on which to draw, younger men may be more dependent on credit as a source of funds. In this study, age of farm operator was significantly associated with the use as well as the amount of production credit (older men made less use of it than younger men) (Table XV in Appendix).

It might be expected that farmers with more education would have greater understanding of credit and its potentialities, and thus a more favorable attitude towards credit. More education may also contribute to a greater managerial capacity, which in turn may lead to more profitable and productive use of credit. Education of farm operator was significantly associated with the use as well as the amount of production credit (Table XVI in Appendix). Forty-four percent of those with less than twelve years schooling were using no credit while 23 percent of those with 12 years or more were not using credit.

Knowledge of Sources and Interest Rates For Production Credit

The majority (73 percent) of farmers were familiar with 3 or more sources of production credit. The percentages were as follows:

No. sources with which familiar	Percent Farm operators
1	5
2	22
3	40
4	20
5 or more	13

Farm operators who had greater information about sources from which credit could be obtained might be expected to make greater use of credit. The association between knowledge of credit sources and amount of production credit, however, was not significant[12]. This result may reflect the fact that even though farmers have knowledge of other sources, if their experience with the present source is favorable they will continue to use it.

About one-fourth of the homemakers and one-half the operators correctly named interest charges from 3 or more sources. Significant relationships were not found between farmers' knowledge of interest charges and personal and family factors examined, as in the case of homemakers. Interest charges and sources have always been a part of the farm management job. Only recently have such charges been emphasized in home management programs.

Use and Source of Real Estate Credit

Credit has long been used to purchase real estate in both farm and non-farm situations. At the time of the interview (Spring 1961), 39.3 percent of the families had debts currently outstanding in connection with the purchase of real estate. The average amount of real estate debt was $11,323 for the 59 families who had it.

Real estate credit was used most frequently to purchase the farm on which the family lived (Table 11). Twenty-four families or 41% of those with real estate debts were using it for this purpose. The Federal Land Bank and individuals were the predominate lenders of such credit.

The next most frequent use of real estate credit was to purchase land other than that on which the family lived. Many of these purchases were for the purpose of enlarging the acreage of the farm operation. Thirteen families (or 22 percent of those with real estate debts) had used credit for this purpose. Banks and individuals most frequently were the source of borrowed funds for this purpose.

Twelve families (20 percent of those with real estate debts) had borrowed to build a new home. Rural as well as urban families of the state are in the throes of a new home wave spreading over the state. As will be recalled, when homemakers were asked about goals not on

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[12] Nor was a relationship found between knowledge of sources of credit and other factors examined; i.e. tenure, willingness to assume debt, amounts of assets, and age and education of operator.

Table 11.—Uses and sources of real estate credit owed by 59 farm families in Mississippi owing real estate credit at the time of the interview, Spring 1961.

		Sources of real estate credit (No.)					
Uses	No. families who owed*	Bank	Insurance company	FHA	FLB	Individual	Other**
Purchase farm	24	1	4	2	9	7	1
Purchase of land other than that on which family lived	13	5	2	--	2	4	--
Family dwelling	12	--	--	6	5	--	1
Re-finance a loan which has come due	6	--	1	2	3	--	--
Consolidate several short term debts	5	2	1	1	1	--	--
Other***	6	1	--	1	3	--	1

*Some families owed for more than one use.

**G.I. loans and Savings and Loan Associations.

***Other uses included: to buy broiler houses; a milking parlor; a new barn.

cards, i.e. "other" goals, 19 mentioned a new home. Two government agencies, the FHA and FLB, were the sources of 11 of the 12 families borrowing for this purpose. The home of the other family was financed by a G.I. loan.

Six families had used credit to refinance loans which had come due, and five families had used real estate as collateral for a loan to consolidate several short term debts.

Real Estate Credit and Related Factors

Family and economic factors considered in relation to the use of credit for real estate purchase and the amounts of credit used include: age of farm operator, number of years farmed, willingness to assume debt, size of the farm in acres, and net worth. (See Tables XVII-XXI in Appendix).

Fifty-one percent of the families of younger operators and 23 percent of older operators had debts outstanding for real estate credit at the time of the interview. The younger men had had less time to pay off debts and. perhaps, because of the prospect of increasing availability of family labor in coming years, were interested in enlarging their farm operation through the purchase of land. These differences in use or non-use of real estate credit were statistically significant at the 1% confidence level.

Differences in amounts of real estate credit outstanding and age were also statistically significant (See Table XVII in Appendix).

In this study farm families were classified according to whether they had farmed less than 15 years, 15 - 29 years, and 30 years or more. The proportion of families who had farmed less than 15 years which had real estate debts, was more than double that of families that had farmed 30 or more years (57.5 and 26.0 percent, respectively). Between these two were families who had farmed an intermediate period, 15 - 29 years. These differences of occurence of real estate debt by number of years farmed were statistically significant. Also, the amount of real estate debts was associated with the number of years farmed See Table XVIII in Appendix).

In this study willingness to assume debt was related to use of as well as amount of real estate debt outstanding (See Table XIX in Appendix). Fifty-seven percent of those most willing to assume debt and 16 percent least willing to assume debt, had real estate debts outstanding. Thirty-seven percent of those with real estate debt most willing to assume debt, and 12.5 percent of those with real estate debt least willing to assume debt, had debts of $10,000 or more.

Since credit might be used to purchase land to enlarge the farm operation it might be expected that the amount of real estate credit would be associated with size of farm in acres. This was the case in this study. Forty-one percent of the farm families with real estate debts outstanding operating less than 75 acres of land owed more than $3,000, while 95 percent of those with real estate debts outstanding operating 250 or more acres owed more than $3,000 (See Table XX in Appendix). This suggests that real estate credit is a force which can be helpful in enlarging the size of farm operation.

Net worth of the farm family would be expected to affect the amount of real estate credit it could obtain. In this study families with higher net worth more often used real estate credit and used it in greater amounts. Twenty-eight percent of the families with net worth under $25,000 and 39 percent with net worth of $60,000 and over were using real estate credit. About 47 percent of those using real estate credit with net worth under $25,000 and 95 percent of those using real estate credit with net worth $60,000 and over had real estate debts of over $3,000. The differences in both use and amounts of real estate credit outstanding when families were classified by their net worth were statistically significant (See Table XXI in Appendix).

Use of Credit by Mississippi and Iowa-Missouri Families

As already stated, this study is similar to one made in 1957 including 203 Iowa and Missouri families. Eligibility requirements for the two studies were the same. By using the Iowa-Missouri definition of a farm family, the majority of farm families in Mississippi are ruled out.

When families in the two samples are compared as to use of credit of the three types, percentages using are similar, as is shown to the right above.

Type of credit	Mississippi sample	Iowa-Missouri sample
	Percent	Percent
One or more types	76.0	71.9
Production	64.7	52.7
Real estate	39.3	37.0
Consumer	30.0	27.1

In both groups more families were using production credit; fewer families, consumer credit.[13]

As is shown, average amounts owed by families having credit in the two areas differ greatly. The Mississippi farm families were using much more credit than were the Iowa-Missouri families.

	Average amount owed by those using.	
Credit	In Mississippi sample	In Iowa-Missouri sample
	Dollars	Dollars
One or more types	11,441	5,072
Production	6,223	2,254
Real estate	11,323	6,420
Consumer	721	583

One factor in this difference was greater net worth of the families in the Mississippi sample. Fifty-seven percent had net worths of $30,000 or more. Only forty percent in the Iowa-Missouri sample had net worths of $30,000 or more. Because Mississippi families had higher net worths they could borrow more.

Net worths of the Mississippi farm families were higher, perhaps, because more farm operators and homemakers in this sample were in the 40-54 year age group than in the Iowa-Missouri sample; fewer in the Mississippi sample were under 40 years of age. The number of farmers and homemakers 55 years and over was about the same in both samples. Then, too, there were fewer tenants in the Mississippi sample (five percent were full tenants compared with nineteen percent in the mid-west sample).

Schooling of farm operators in the two areas was similar but schooling of Mississippi homemakers was somewhat better than schooling of homemakers in Iowa-Missouri. Twenty percent of the Mississippi homemakers had had one or more years of college; only eleven percent of the Iowa-Missouri homemakers had had this much schooling. Twenty percent of the Mississippi homemakers and twenty-nine percent of the Iowa-Missouri homemakers had finished less than nine grades in school.

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[13] See report, "Credit and Other Factors Affecting Family Security," by Gordon E. Bivens. (Paper given at the American Home Economics Annual Meeting, Miami Beach, Florida, June 28, 1962.) The manuscript in its present form is limited to a discussion of uses and sources of credit and did not include related data on goals, background of husband and wife, etc.

Willingness to assume debt was about the same in families of both areas.

Not only were percentages similar of families in the two areas with credit outstanding, but also uses and sources of the credit. Consumer credit was used most frequently for an auto by families in both areas. Many families obtained credit from dealers and commercial banks. Finance companies were used by many dealers.

Production credit was used most frequently in both areas for "general operating" expenses. In other words, the farmer borrowed a lump sum which he used for many purposes. Families in both areas most often obtained this credit from banks and from the Production Credit Administration.

More families in both studies were using real estate credit to help buy the farm on which the family was living. In Mississippi the Federal Land Bank and individuals were most often financing the undertaking; in Iowa and Missouri, the commercial bank and individuals.

Certain factors were associated with the use and amount of credit used in both Mississippi and Iowa-Missouri. These were: **Consumer Credit,** knowledge of sources of credit by homemaker; **Production Credit,** amount of family assets, age and education of farm operator; **Real Estate Credit,** size of farm, age of farm operator, and number years operator farmed.

From this comparison it would seem that farm families in the two areas are not too different in respect to use of credit, eligibility requirements being the same. Mississippi's career farmers are like those of Iowa and Missouri, but Mississippi has fewer career farmers.

Summary

It was the purpose of this study (1) to study ways in which families who make a career of farming use consumption, production, and real estate credit; and (2) to analyze the relation of certain factors to uses of the three forms of credit.

The methods and techniques of this study closely follow a study being made in Iowa and Missouri as part of the North central Regional Project, NC-32.

Included in this study were 150 white families, 30 from each of five counties in Mississippi; namely, Calhoun, Jefferson, Lamar, Leake, and Leflore. Farm operators and homemakers were interviewed during the spring of 1961 with the use of schedules.

To be eligible for the study the family must have contained both husband and wife who had been married at least one year and had operated a farm the past year; must have derived last year at least one-half their cash income from farming; and this year operate 30 acres of land or more. Only white families were included. There were eligible families in 9 percent of the dwellings shown on the highway maps used in sampling. Schedules were completed for all eligible families except 12.

About one-third of the families (30 percent) had 5 or more members; 40 percent had 3 or 4 members; and 30 percent, 2 members. Forty-one percent of the operators and 26 percent of the homemakers were 55 years or over. Homemakers had more schooling than husbands. Fifty-one percent of the wives and 40 percent of the husbands finished high school or attended college.

According to farm operators and homemakers, their parents had been more favorable to use of producer than consumer credit, and more favorable to use of real estate credit than producer credit.

The great majority of farm operators and their wives included in this study had spent most of their lives on a farm. But somewhat more wives than husbands had lived at various periods of their lives in areas other than the farm.

Thirty-three percent of the farm operators and 39 percent of their wives had never had work off the farm. The number of husbands and wives having work off the farm during 1960 was relatively low. Days worked and earnings in 1960 were less however, than expected in 1961.

Sixty percent of the families owned all the land they operated; 35 percent owned part and rented part; and five percent were full tenants. Thirty-six percent operated less than 75 acres; 37 percent operated 75-249 acres; and 27 percent operated 250 acres or more.

The "general" farm was most typical. The net worth of 35 percent of the families was under $25,000; of 30 percent, $25,000 - $59,999; and of 35 percent, $60,000 and over.

At the time of the interview, spring 1961, 19 percent of the families were participating in programs of the Farmers Home Administration; 7 percent in the Balanced Farm and Home Program of the Mississippi Agricultural Extension Service; and two percent in both of these.

More statistically significant relationships were found between long-run goals of the family and age of homemaker than between long-run goals and other factors examined. More younger than older women mentioned expanding size of farm enterprise, reducing their indebtedness, and providing for special education of their children. More women with less education and from families of lower net worth mentioned gaining and maintaining respect of their neighbors and other community members as a long-run goal. More part than full owners mentioned reducing indebtedness.

When homemakers were given cards containing statements of opinion which some people have about credit and asked about agreement or disagreement with these statements, one found in their replies full realization of the need for large-scale farm production and use of credit under certain conditions.

Each homemaker and farm operator was shown six drawings and a statement on each depicting hypothetical situations involving use of credit. More than two-thirds of these husbands and wives agreed on the use of credit in four, five, or all six situations.

About three-fourths of the families (76.0 percent) had some type of credit outstanding in the spring of 1961. The average debt of those using credit was $11,441. Twenty-three families were using all three kinds of credit, forty-one families were using two types of credit, and fifty families were using only one type of credit.

Thirty percent of the families had consumer credit outstanding. Of those with consumer debt, the average amount outstanding in the spring of 1961 was $721. The families included were using consumer credit for purchase of an automobile more often than for any other purpose. The next most frequent use of consumer credit was for washing machines; doctor and hospital bills were third in importance. Dealers, banks, and finance companies (such as GMAC; CIT) were the most frequent sources of consumer credit. Convenience was the most important reason given for use of the specified source.

Significant relationships were found between use of consumer credit and age of homemaker and between use of consumer credit and number of sources of credit with which the homemaker was familiar. Nearly two-thirds of the homemakers were familiar with three or more sources of consumer credit.

Significant relationships were found between homemaker's knowledge of interest rates and her schooling, her willingness to assume debt, and the net worth of the family. Twenty-eight percent of the homemakers reported interest rates correctly from three or more sources.

In the spring of 1961, 97 of the 150 families (64.7 percent) had production credit outstanding. Of those with production debt the average amount outstanding was $6,223. Production credit was used most frequently for "general operating" expenses. Other important uses of production credit were for new machinery and equipment, livestock, fertilizer and lime, and seed. The most important sources of production credit were banks, dealers, PCA, and FHA in the order named. Convenience was the reason most often given for use of source, but more farm operators had mentioned cost in connection with production credit than had homemakers in connection with consumer credit.

Size of farm and total assets had a significant association with the use farm families made of production credit. A chi square test of difference in full and part owners revealed a significant association between tenure and use of production credit. Also part owners used larger amounts of production credit than full owners.

There was a highly significant difference in amount of debts outstanding and net worth. Families with high net worth used relatively large amounts of credit. Age and education of farm operator as well as willingness to assume debt were significantly associated with use as well as amount of production credit.

Seventy-three percent of the farm operators were familiar with three or more sources of production credit. About one-half the farm operators reported interest rates correctly from three or more sources. Significant relationships were not found between farmers' knowledge of interest charges and personal and family factors examined, as in the case of the homemaker.

About thirty-nine percent of the 150 families had real estate credit outstanding. Of those with real estate debt, the average amount outstanding in the spring of 1961 was $11,323. The families included were using real estate credit more often to purchase a farm than for any other purpose. Credit to purchase land other than that on which the family lived, and to purchase a family dwelling were next uses in importance. The Federal Land Bank, Farmers Home Administration, and individuals were the sources of real estate credit most often used.

The differences between use and between amounts of real estate credit outstanding and age of operator, years operator farmed, net worth of family, and willingness to assume debt, were statistically significant. Also, amount of real estate credit was associated with size of farm in acres.

When the same eligibility requirements were used in selection of farm families in Mississippi as used in selection of farm families in Iowa-Missouri, use of credit resources by the two groups were not too different. Mississippi's career farmers are very much like those of Iowa and Missouri, but Mississippi has fewer career farmers. Those who do meet these criteria, however, appear to be of somewhat higher socio-economic status than the larger Iowa-Missouri group meeting such criteria.

With increased industrialization and migration in Mississippi, more small farms are becoming larger and the number of career farm families will further increase. This means need for more emphasis on programs for farm families on uses and sources of credit. "Career" farmers are the group who have greatest need for use of such credit.

From this study it is concluded that use of credit is important to the farm family because with judicious use of credit it can bring about larger and more profitable farms as well as higher levels of living. The families themselves are realizing this fact. Therefore, it behooves families, educators, and related groups to develop and promote more and better programs on the sources and use of credit.

APPENDIX A

Tables

Table 1.—Relationship of ~~four~~ 14 long-run family goals to specified factors.

Goals	Age homemaker	Net worth	Willingness to assume debt	Tenure	Ed. homemaker	Socio-economic rating
Improve farm land						
Increase total production of farm						
Own our farm, or add to amount of land or real estate we own						
Expand the size of the farm enterprise	*					
Add to or improve farm buildings and/or such fixed equipment as fences, water system for livestock						
Reduce our indebtedness or get out of debt	*			*		
Increase savings account						
Add to movable furnishings or household equipment						
Improve the house itself or add water system, kitchen cabinets						*
Improve the yard and exterior appearance of the house						
Provide for special education of children including college	*					
Promote recreational activities by each family member or as a family group						
Gain and/or maintain respect of my neighbors and other community members		*			*	
Take part in community affairs and organizations						
None						

*Significant at the 5% level according to Chi-square tests.

Table II.—Relationship of ~~four~~ 14 short-run family goals to specified factors.

Goals	Age homemaker	Net worth	Willingness to assume debt	Tenure	Ed. homemaker	Socio-economic rating
Improve farm land						
Increase total production of farm						
Own our farm, or add to amount of land or other real estate we own						
Expand the size of the farm enterprise						
Add to or improve farm buildings and/or such fixed equipment as fences, water system for livestock						
Reduce our indebtedness or get out of debt						
Increase savings account						
Add to movable furnishings or household equipment	*					
Improve the house itself or add water system, kitchen cabinets						
Improve the yard and exterior appearance of the house						
Provide for special education of children, including college	*					
Promote recreational activities by each family member or as a family group						
Gain and/or maintain respect of my neighbors and other community members						
Take part in community affairs and organizations						
None	**	*	**		**	**

*Significant at the 5% level according to chi-square tests.
**Significant at the 1% level acording to chi-square tests.

Table III.—Percentage of homemakers classified by opinion of 7 statements concerning credit.

Statement*	Definitely agree	Agree somewhat	No opinion	Disagree somewhat	Definitely disagree	Total
			Percent			
No. 1	42	11	1	16	30	100
No. 4	71	19	1	6	3	100
No. 6	49	13	9	7	22	100
No. 7	10	5	3	16	66	100
No. 8	27	16	7	17	33	100
No. 9	3	5	2	7	83	100
No. 10	27	23	9	17	24	100

*For a list of statements see discussion under "Willingness to assume debt", page 9.

Table IV.—How homemakers and farm operators would use money in six situations.*

Situation and use	Homemakers	Farm operators
	Percent	Percent
Situation (1)		
Don't know	1	1
Checked (a)	69	77
Checked (b)	21	15
Checked (a) and (b)	9	7
Situation (2)		
Don't know	2	1
Checked (a)	39	57
Checked (b)	53	41
Checked (a) and (b)	6	1
Situation (3)		
Don't know	8	9
Checked (a)	32	35
Checked (b)	53	51
Checked (a) and (b)	7	5
Situation (4)		
Don't know	1	3
Checked (a)	51	67
Checked (b)	28	11
Checked (a) and (b)	20	19
Situation (5)		
Don't know	1	0
Checked (a)	63	82
Checked (b)	23	6
Checked (a) and (b)	13	12
Situation (6)		
Don't know	1	2
Checked (a)	44	45
Checked (b)	52	51
Checked (a) and (b)	3	2

*See situations under discussion, "Use of Credit — Six Hypothetical Situations", page 11.

Table V.—Consumer credit outstanding of 150 Mississippi farm families by age of homemaker.[1]

Credit outstanding	Age of homemaker: Under 39 yrs.	Age of homemaker: 40-54 yrs.	Age of homemaker: 55 yrs. and over	No. families
	No.	No.	No.	
Had none	21	50	34	105
Had some	14	26	5	45
Total	35	76	39	150

[1] X^2 equals 7.79 (2 d.f.); $P < .05$.

Note: There were too few families with consumer credit outstanding to sub-classify into amounts owed.

Table VI.—Consumer credit outstanding of 150 Mississippi farm families by composition of family.[1]

Credit outstanding	No children	All children 13 & under	All children 14 and over	Children miscellaneous ages	Total No. families
	No.	No.	No.	No.	
Had none	47	20	19	19	105
Had some	11	15	7	12	45
Total	58	35	26	31	150

[1] X^2 equals 7.35 (3 d.f.) Note: X^2 would need to be 7.81 to be significant at the 5% level.

Table VII.—Consumer credit outstanding of 150 Mississippi farm families by number of sources of credit with which homemaker familiar.[1]

Credit outstanding	1 or 2 sources	3 sources	4 or 5 sources	Total No. families
	No.	No.	No.	
Had none	45	38	22	105
Had some	9	17	19	45
Total	54	55	41	150

[1] X^2 equals 9.81 (2 d.f.); $P < .05$.

Table VIII.—Number of sources of consumer credit with which homemaker familiar, classified by age of homemaker.[1]

Number	Age of homemaker			Total
sources credit	Under 39 yrs.	40-54 yrs.	55 yrs. or over	No. families
	No.	No.	No.	
1 or 2	8	26	20	54
3	14	27	14	55
4 or 5	13	23	5	41
Total	35	76	39	150

[1] X^2 equals 8.89 (4 d.f.) Note: X^2 would need to be 9.49 to be significant at the 5% level.

Table IX.—Number of correct interest rates given by homemaker classified by her education.[1]

No. correct	Education of homemaker				Total
interest rates	8 grades or less	9-11 grades	12 grades	1 or more college	No. families
	No.	No.	No.	No.	
0 or 1	11	21	8	3	43
2	7	17	21	19	64
3 or more	11	5	16	9	41
Total	29	43	45	31	148*

*Two gave no information on schooling.

[1] X^2 equals 23.83 (6 d.f.); $P < .01$.

Table X.—Number of correct interest rates given by homemaker classified by score for willingness to assume debt.[1]

No. correct interest rates	13 & under	14-19	20 &over	Total No. families
	No.	No.	No.	
0 or 1	20	17	6	43
2	16	21	28	65
3 or more	14	15	13	42
Total	50	53	47	150

[1] X^2 equals 11.12 (4d.f.); $P < .05$.

Table XI.—Number of correct interest rates given by homemaker classified by net worth of family.[1]

No. Correct interest rates	Under $25,000	$25,000-$59,999	$60,000 and over	Total No. families
	No.	No.	No.	
O or 1	22	13	8	43
2	15	19	31	65
3 or more	16	13	13	42
Total	53	45	52	150

[1] X^2 equals 12.46 (4 d.f.); $P < .05$.

Table XII.—Amount of production credit owed, classified by farm tenure.[1]

Amount production credit	Own all	Own part	Total No.[2] families
	No.	No.	
None	43	10	53
$1500 and under	20	7	27
$1501 - $4500	17	15	32
$4501 and over	10	20	30
Total	90	52	142

[1] X^2 equals 21.66 (3 d.f.); $P < .01$.

[2] Excludes the 8 tenant families.

Table XIII.—Amount of production credit owed, classified by net worth of family.[1]

Amount production credit[2]	Under $25,000	$25,000-$59,999	$60,000 and over	Total No. families
	No.	No.	No.	
None	23	15	15	53
$1500 and under	14	12	6	32
$1501 - $4500	11	12	11	34
$4501 and over	5	6	20	31
Total	53	45	52	150

[1] X^2 equals 18.04 (6 d.f.); $P < .01$.

[2] Relationship between use and non-use of production credit and net worth was not significant (X^2 equals 2.54 with 2 d.f.). Note: X^2 would need to be 5.99 to be significant at the 5% level.

Table XIV.—Amount of production credit owed classified by score for willingness to assume debt.[1]

Amount production credit[2]	13 & under	14-19	20 & over	Total No. families
	No.	No.	No.	
None	28	18	7	53
$1500 & under	10	7	15	32
$1501 - $4500	8	9	17	34
$4501 and over	4	19	8	31
Total	50	53	47	150

[1] X^2 equals 31.39 (6 d.f.); $P < .01$.

[2] Relationship between use and non-use of production credit and willingness to assume debt was: X^2 equals 17.98 (2 d.f.); $P < .01$.

Table XV.—Amount of production credit owed classified by age of farm operator.[1]

Amount of production credit[2]	55 yrs. & under	55 yrs. & over	Total No. families
	No.	No.	
None	22	31	53
$1500 & under	22	10	32
$1501 - $4500	25	9	34
$4501 and over	20	11	31
Total	89	61	150

[1] X^2 equals 11.34 (3 d.f.); $P < .01$.

[2] Relationship between use and non-use of production credit and age of farm operator was: X^2 equals 10.80 (1 d.f.); $P < .01$.

Table XVI.—Amount of production credit owed classified by education of farm operator.[1]

Amount production credit[2]	8 grades or less	9-11 grades	12 grades	1 or more college	Total No.[3] families
	No.	No.	No.	No.	
None	24	15	10	4	53
$1500 & under	11	10	7	4	32
$1501 - $4500	9	7	12	5	33
$4500 & over	2	10	6	12	30
Total	46	42	35	25	148

[1] X^2 equals 26.03 (5 d.f.); $P < .01$.

[2] Relationship between use and non-use of production credit and education of farm operator was: X^2 equals 10.42 (3d.f.); $P < .05$.

[3] There was no information on schooling of two farm operators.

Table XVII.—Amount of real estate credit owed classified by age of farm operator.[1]

Real estate credit[2]	54 years & under	55 yrs. & over	Total No. families
	No.	No.	
None	44	47	91
$3,000 and under	14	3	17
$3001 - $9,999	17	6	23
$10,000 and over	14	5	19
Total	89	61	150

[1] X^2 equals 11.92 (4 d.f.); $P < .01$.

[2] Relationship between use and non-use of real estate credit and age of operator was: X^2 equals 11.56 (1 d.f.); $P < .01$.

Table XVIII.—Amount of real estate credit owed classified by number of years husband farmed on own.[1]

Real estate credit[2]	Less than 15 yrs.	15-29 yrs.	30 yrs. & over	Total No. families
	No.	No.	No.	
None	17	37	37	91
$3,000 and under	8	6	3	17
$3001 - $9,999	10	6	7	23
$10,000 and over	5	11	3	19
Total	40	60	50	150

[1] X^2 equals 14.55 (6 d.f.); $P < .05$.

[2] Relationship between use and non-use of real estate credit and years husband farmed was: X^2 equals 9.29 (2 d.f.); $P < .01$.

Table XIX.—Amount of real estate credit owed classified by score for willingness to assume debt.[1]

Real estate credit[2]	13 & under	14-19	20 & over	Total No. families
	No.	No.	No.	
None	42	29	20	91
$3,000 and under	3	5	9	17
$3001 - $9,999	4	11	8	23
$10,000 and over	1	8	10	19
Total	50	53	47	150

[1] X^2 equals 21.64 (2 d.f.); $P < .01$.

[2] Relationship between use and non-use of real estate credit and score for willingness to assume debt was: X^2 equals 18.66 (2 d.f.); $P < .01$.

Table XX.—Amount of real estate credit owed classified by size of farm in acres.[1]

Real estate credit[2]	Under 75	75-249	250 & over	Total No. families
	No.	No.	No.	
None	37	33	21	91
\$3,000 and under	10	6	1	17
\$3001 - \$9,999	5	11	7	23
\$10,000 and over	2	5	12	19
Total	54	55	41	150

[1] X^2 equals 21.57 (6 d.f.); $P < .01$.

[2] Relationship between use and non-use of real estate credit and size of farm was: X^2 equals 2.94, not significant.

Table XXI.—Amount of real estate credit owed classified by net worth of family.[1]

Real estate credit[2]	Under \$25,000	\$25,000-\$59,999	\$60,000 and over	Total No. families
	No.	No.	No.	
None	38	21	32	91
\$3,000 and under	8	8	1	17
\$3001 - \$9,999	6	9	8	23
\$10,000 and over	1	7	11	19
Total	53	45	52	150

[1] X^2 equals 18.20 (6 d.f.); $P < .01$.

[2] Relationship between use and non-use of real estate credit and net worth of family was: X^2 equals 26.42 (3 d.f.); $P < .05$.

APPENDIX B
Socio-Economic Scale

		Score
1. Rooms per person	2.00 & up	3
	1.99 - 1.00	2
	Below 1.00	0
2. Floors living room finished	Yes	3
	No	0
3. Living room lounge	Bed, cot, bench, none	0
	Divan or studio couch	3
	Couch or day bed	2
4. Installed bath tub or shower	Yes	3
	No	0
5. How far did wife go in school	Less than 9 grades	0
	9-12 grades	2
	College one or more years	3
6. How far did husband go in school	Less than 9 grades	0
	9-12 grades	2
	College one or more years	3
7-18. Equipment owned:		
7. Telephone	Yes	3
8. Vacuum cleaner	Yes	3
9. Automatic washer	Yes	3
10. Home freezer	Yes	3
11. Furniture insured	Yes	3
12. Car, other than truck	Yes	3
13. If Yes, is model past two years	Yes	3
14. Septic tank* or cesspool	Yes	3
15. Electric sewing machine	Yes	3
16. Piano	Yes	3
17. Electric clock	Yes	3
18. Television	Yes	3

*There were some families with flush toilets who did not have a septic tank or cesspool. Waste drained in bayou or slough. More than 80% had a flush toilet.

APPENDIX C
Interest Charges

Agency	Rate of Interest
FHA	4-5%
PCA	6-7%
Federal Land Bank	5½-7%
Finance Companies (such as GMAC and CIT)	15-20%
Banks	6-8%
Dealers selling on installment	8-20%
Borrow on life insurance	5-8%
Small loan agency	15-30%
Individuals	5-8%
First Federal and other Savings & Loan associations	6-7%
GI	5¼%
Sears, Roebuck and Co.	12-15%
Staple Cotton Cooperative Assoc.	6%
Farmers Coop (on accounts over 60 days)	10-12%
Credit Union	6%

BULLETIN 659 FEBRUARY, 1963

Estimated Population Trends, Mississippi 1960-61

By ELLEN S. BRYANT

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STATE COLLEGE MISSISSIPPI

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ESTIMATED POPULATION TRENDS, MISSISSIPPI, 1960-61

By ELLEN S. BRYANT

A reversal in population trends seems to be occurring in Mississippi since the 1960 Census was taken. Population estimates for 1961 indicate that the state is experiencing the beginning of a net inmigration of white persons and a continued, but declining, net outmigration of nonwhites. Figures released by the U. S. Bureau of the Census set the state's total population at 2,248,000[1] in July of 1962, representing a gain of 3.2 percent since April of 1960. In 1961, the state's population reached an estimated, average size of 2,212,600[2] for a gain of about 1.6 percent. The estimated numerical increase in Mississippi's inhabitants amounts to about 30 thousand for each year since the Census was taken.

The population increases seem to be spread throughout a majority of the counties in the state and are apparently the result of growth of both the white and nonwhite groups which in 1961 increased by 2.16 and 0.80 percents respectively. And, although 1962 white, non white, and county figures are not yet available, it is reasonable to assume the continuation of approximately the same rates of increase into the second postcensual year. As indicated above, the percent of gain for the white population is larger than can be accounted for by natural increase alone, while that for nonwhites is less than would have accrued from the retention of natural increase. For an estimate of Mississippi's migration during the period from the Census to mid-1961, see Table 1.

The change in trends evidenced by the 1961 and 1962 estimates is somewhat startling in view of the extremely heavy population losses the state has experienced over the last two decades when a net of about 800,000 left the state. Because of the abruptness of the indicated change the new trends should be viewed and analyzed with caution—in spite of the strong evidence of their reality—until at a future date it can be established whether they are only temporary fluctuations in the historic trend or real indicators of the start of a permanent expansion of Mississippi communities and their economics.

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[1] U. S. Bureau of the Census, **Current Population Reports, Special Censuses,** Series P-25, No. 259, November 26, 1962.

[2] The estimates for 1961 were prepared by the Division of Sociology and Rural Life, Mississippi State University. This figure is the total of county white and nonwhite estimates. No county or white and nonwhite estimates have been prepared for 1962, because the data on which they are based are not yet available. The Census Bureau estimate for 1961 was 2,217,000. See **Current Population Report,** P-25, No. 258, November 2, 1962.

Table 1.—Estimated net migration, Mississippi, from April 1, 1960 to July 1, 1961.

Mississippi Population	1960 Population	Natural Increase	Total Expected Population[1]	Estimated Average 1961 Population	Estimated Net Migration[2]
Total	2,178,141	47,268	2,225,682	2,212,580	—13,100
White	1,257,546	20,182	1,277,728	1,284,660	+ 6,930
Nonwhite	920,595	27,086	947,681	927,920	—19,760

[1] Col. 1 plus Col. 2.

[2] Col. 4 minus Col. 3.

Estimates are rounded. Data Sources: U. S. Bureau of the Census and Mississippi State Board of Health.

Trends in the economy, however, do offer some explanation of the new population growth. Growth in manufacturing has been steadily increasing in Mississippi after hitting a low in February of 1961, when both the state and national economies were experiencing a recession. The Mississippi Agricultural and Industrial Board reports that in 1961, record numbers of new and expansions of old industry were acquired by Mississippi.[3] It is reasonable to hypothesize (in view of the historical evidence of return migration during the depression '30's) that the curtailment of job opportunities on the national level occurring in 1960 and early 1961 may have cancelled much of Mississippi's outmigration and could also have triggered a return movement of white Missisippians who had previously left the state in search of better economic opportunities. The economic expansion since that time could then have easily absorbed many of the stayees and returnees and attracted more inmovement, particularly of skilled, managerial persons essential to operating new manufacturing plants.

The actual amount of employment in manufacturing dropped slightly during 1961 after having increased about 5 percent in 1960. However, construction employment regained three-fifths of 1960 losses in 1961 and increases were also noted in employment in services and finance.[4] New construction has been and is very much in evidence throughout many sections of the state, making it obvious that new industries are being added to the state's economy.

The full impact of the new industry gained by the state in 1961 has probably not yet been felt, and it seems reasonable to asume that the state is continuing and possibly accelerating the population and industrial growth instigated in 1961.

Jobs in agriculture were also on the upswing in the state during 1961. Total annual wages paid in agriculture, fishing and forestry were 18.5 percent higher in 1961 than in 1960.[5] These figures suggest the possibility that the severe losses of farm population during the 1950's have at least temporarily leveled off.

The Index of Business Activity in Mississippi, prepared by the Bureau of Business and Economic Research at Mississippi State University, is also charting an accelerated increase in the economic activity in the state since 1961. Comparing the indexes for September of the last three years there is an increase from 126 to 149 percent over the 1956-1958 level of activity.[6]

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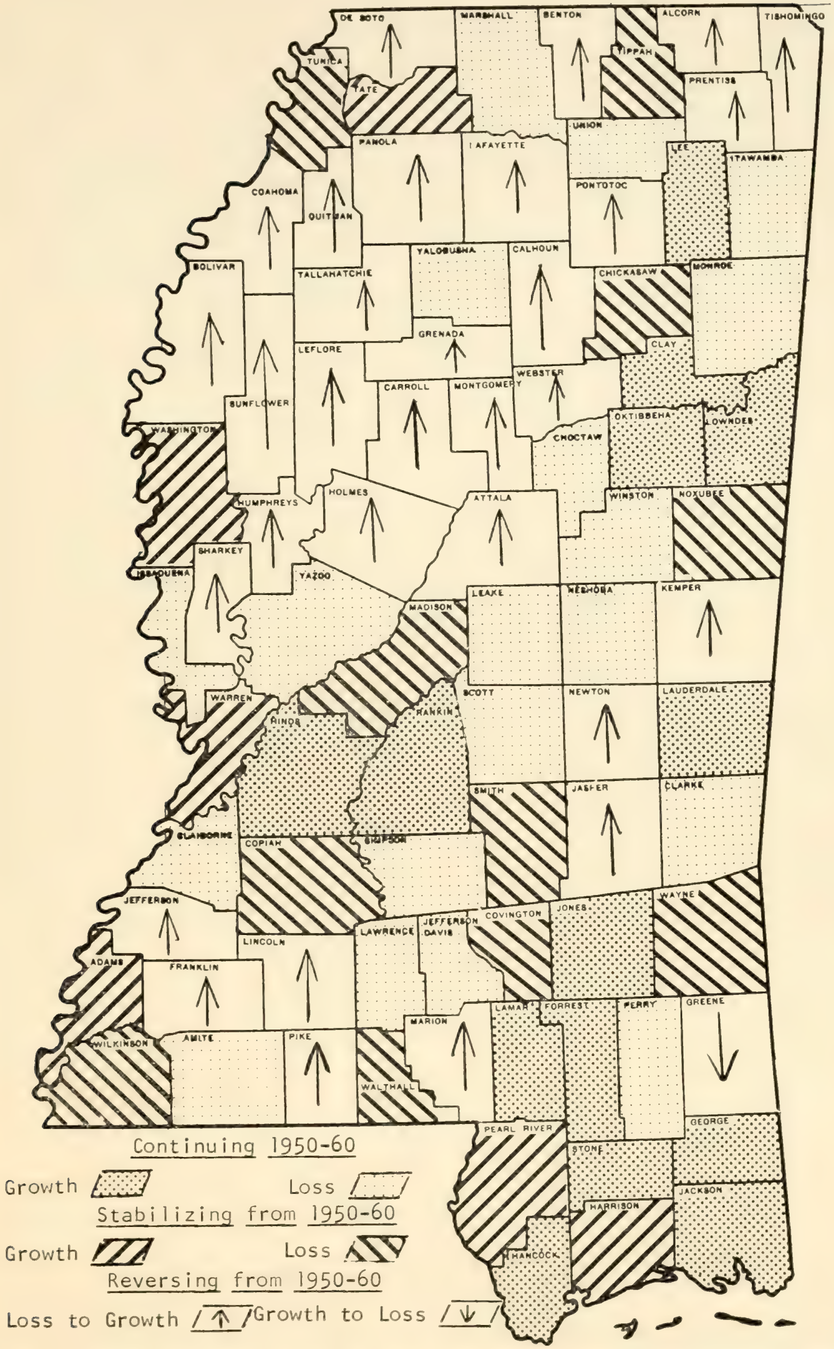
[3] "Mississippi's Economy Continues to Expand," **Monthly Review,** Federal Reserve Bank of Atlanta (October, 1962).

[4] The figures given refer only to employment covered by the Mississippi Employment Security Law. See **Monthly Employment and Quarterly Wages of Workers Covered by the Mississippi Employment Security Law, By County and Industry for the Calendar Years, 1959, 1960, and 1961,** Reports of the Mississippi Employment Security Commission.

[5] Refers to wages covered by the Mississippi Employment Security Law. "Average Quarterly Employment and Total Annual Wages," **Jobs Index** of Mississippi Employment Security Commission, 24:3 (Third Quarter 1961) and 25:3 (Third Quarter 1962).

[6] **Mississippi Business Review** 24:5 (November 1962) and 23:5 (November, 1961).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PERRY
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PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK
Continuing 1950-60
Growth
Loss
Stabilizing from 1950-60
Growth
Loss
Reversing from 1950-60
Loss to Growth
Growth to Loss

Figure 1. Estimated 1961 trends in the total population of Mississippi counties related to 1950 to 1960 trends.

1961 COUNTY WHITE AND NONWHITE ESTIMATES

Geographic Pattern

Total population estimates for Mississippi counties in 1961 show: (1) 17 percent of the counties have continued in population growth, (2) that losses shifted to gains in over one-third of the counties, and (3) in another 13 percent there was a leveling-off of previous losses. Less than one-fourth of the counties seem to be continuing a decline in total population size. The map, Figure 1, indicates what is happening to population trends in the counties. Most of the reversals from loss to growth have occurred in the northern half of the state, both in the hill counties and in the Mississippi Delta. A third cluster of new growth is in the southeast corner of the state. Continuing losses are indicated in a somewhat vertical band of counties in the middle of the state and in scattered border counties.

In general, this geographic change pattern for the total county populations is duplicated by both racial groups. Figures 2 and 3 give white and nonwhite county patterns. However, some notable differences between the races can be observed. In the Delta, more counties have reversed to growth of nonwhite population than of white, while in North and Central Mississippi more counties have initiated white population growth.

Only eight counties are continuing to decrease in size of both white and nonwhite populations in the new decade. For the most part, loss of people from one color group seems to be offset by either gain or stabilization in the size of the other. Nevertheless, more counties were experiencing continued losses of nonwhites than whites, and in addition several counties on or close to the coast showed a reversal from increase to loss of nonwhites in 1961. In all, thirty-one counties were declining in number of nonwhites in 1961, while only seventeen were registering net losses in whites.

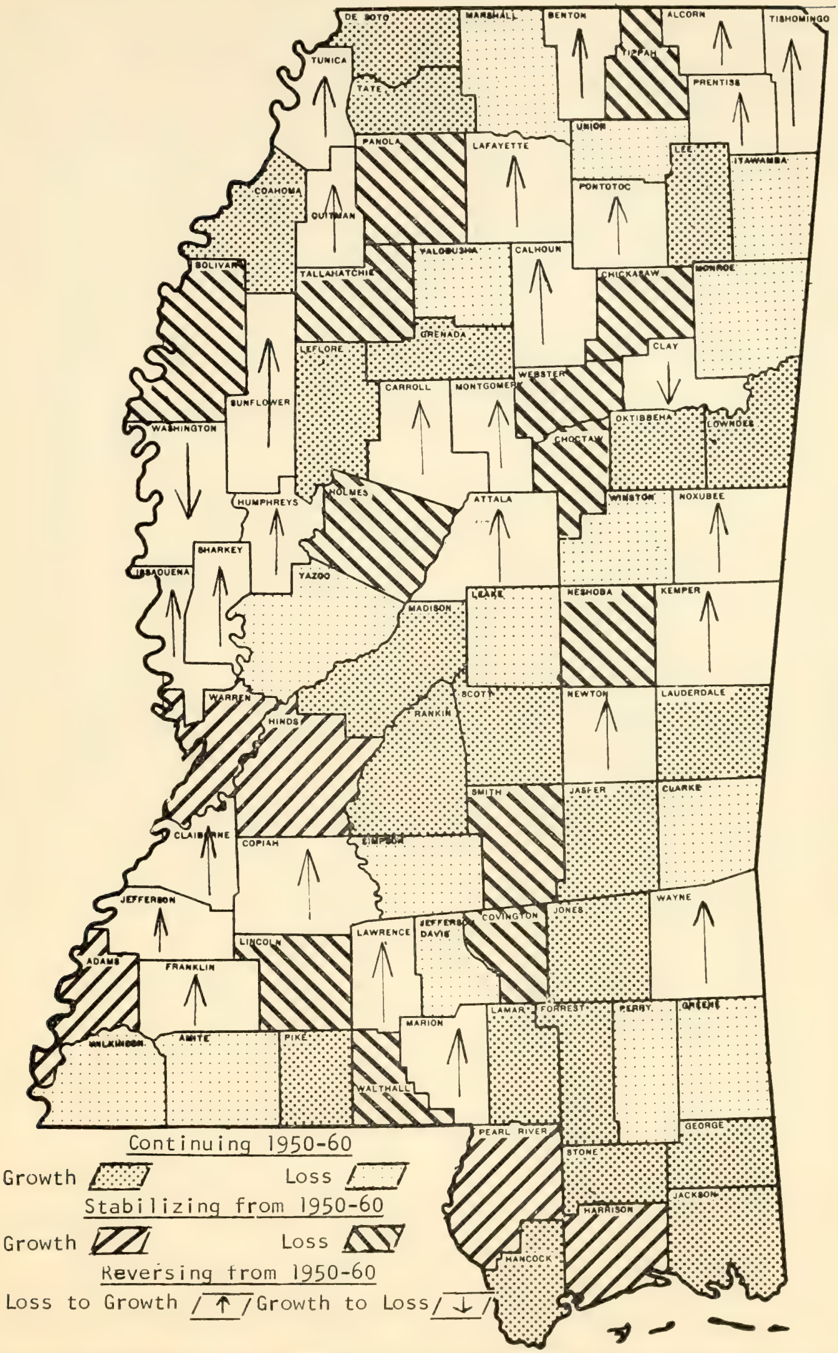
Table 2.—Types of population change in Mississippi counties, April 1960 to July 1961.

Type of Change	Population		
	Total	White	Nonwhite
	No.	No.	No.
Counties growing:			
Continuation[1]	14	21	7
Reversal[1]	31	26	29
Total	45	45	36
High rates of Growth[2]	14	23	8
Counties Losing:			
Continuation[1]	19	15	25
Reversal[1]	1	2	6
Total	20	17	31
High rates of Loss[2]	4	2	8
Counties Stabilizing[3]			
After Gaining 1950-60	6	5	2
After Losing 1950-60	11	13	13
Total	17	18	15
Total Number Counties	82	82	82

[1] Of 1950 to 1960 Trends.

[2] Over 5%

[3] Gaining or losing one percent or less.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CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
JONES
WAYNE
COVINGTON
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WALTHALL
PEARL RIVER
GEORGE
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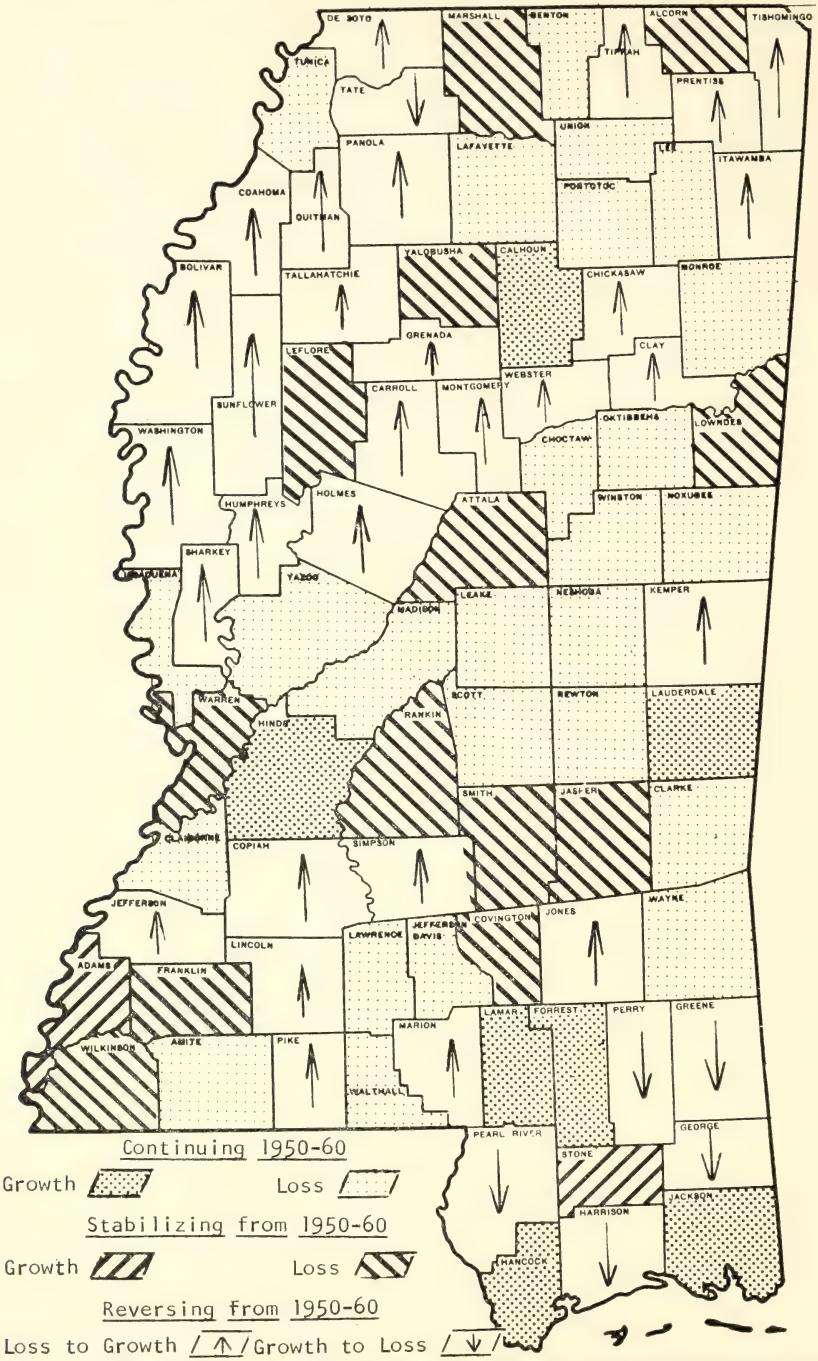
JACKSON
HARRISON
HANCOCK
Continuing 1950-60
Growth
Loss
Stabilizing from 1950-60
Growth
Loss
Reversing from 1950-60
Loss to Growth / ↑ /
Growth to Loss / ↓ /

Figure 2. Estimated 1961 trends in the white population of Mississippi counties related to 1950 to 1960 trends.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ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
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JEFFERSON
WAYNE
JONES
COVINGTON
LAWRENCE
JEFFERSON DAVIS
LINCOLN
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
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MARION
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PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK
Continuing 1950-60
Growth
Loss
Stabilizing from 1950-60
Growth
Loss
Reversing from 1950-60
Loss to Growth
Growth to Loss

Figure 3. Estimated 1961 trends in the nonwhite population of Mississippi counties related to 1950 to 1960 trends.

Thus the trend for an increasingly higher proportion of whites in Missisippi's population seems to be continuing, both for the state as a whole and for most of the individual counties.

Types of County Change

Table 2 shows the numerical distribution of counties according to the kind of population change experienced by the white, nonwhite, and total populations. Three main and several subclasses of change were delimited.[7] Basically, counties were classified as: (1) growing, if their rates of increase exceeded one percent; as (2) losing, if their rates of decrease exceeded one percent; or as (3) stable, if they either gained or lost one percent or less.

First, let us examine the growing counties, which, in terms of new types of community change are most significant. Growing counties were sub-grouped into those perpetuating an earlier trend, those which have reversed from previous losses to gains, and those (drawn from the above two sub-types) which had growth rates in excess of 5 percent.

The white population shows a greater tendency for continuous growth. For every county which continued to have an increase in nonwhite population three continued their increases in whites. As the map indicates, most of the continuous growth has been in counties which have or are close to sizeable centers of urban and industrial development. Lowndes, Lee and Jones Counties are typical. Continued nonwhite growth, although not nearly as widespread is also chiefly in counties of considerable urban development, although the continued increase in number of nonwhites in Calhoun County is possibly related to this area's development of truck farming which requires large amounts of hand labor.

The most surprising development in population change in the state is the about-face in many of the counties from loss to gain. For both the total population and the population divided by color, roughly one-third of the counties changed from losing to gaining inhabitants. In fact, three more counties reversed to growth in number of nonwhites than to growth of whites. In several of the counties, particularly in the Delta, nonwhite growth was a sizeable factor in influencing total population growth. In all probability the nonwhite increases in the Delta and in other essentially rural counties have accrued to the farm population.

The widespread distribution of the new growth trends in the state is also an indication that many of the smaller cities as well as areas adjoining the larger cities are experiencing spurts of industrial and urban growth. This is particularly noticeable in the map charting white population trends. See for instance, Tunica County, across the river from Helena. Arkansas; Alcorn County with Corinth. Coahoma with Clarksdale; Grenada with Grenada; Montgomery with Winona; Attala with Kosciusko; as well as Marion, Lawrence and Copiah Counties, all of which have relatively small but developing centers of growth.

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[7] A change of one percent or less in either direction was considered insignificant because (1) small errors in recording the data on which the estimates were based might conceivably account for this much variation; (2) small area population estimates, such as are usually found in a county, are more subject to sporadic and temporary variations which may not be meaningful in the long run; and (3) the annual average rate of growth in the United States was about 2.1% in 1961 or somewhat less than the net growth for the whites in Mississippi between 1960 and 1961.

Gains in excess of five percent were indicated in many counties for the white population and in a few for the nonwhite. A small number of counties, all of which had been previously losing, showed rates of gain which exceeded 10 percent. Extremely high rates of change for a county must be viewed with a great deal of caution. Small population units are often subject to temporary fluctuations in size. Also what is actually a small numerical change can be represented as a high proportional gain when the original base is small.

All of the county populations showing growth rates in excess of 10 percent were under about 15 thousand in size. Nevertheless, although the rates of change may be exaggerated in some of the counties by these estimates, the tendency for high increase rates to concentrate in the white population while high loss rates cluster in the nonwhite, is in accord with the generalized state trend and indicates that the estimates are measuring direction of change consistently.

Assuming the reality of growth in those counties recording extreme rates of gain, we can conclude that some of Mississippi's counties which, up to this time, have been very isolated and highly rural may be experiencing population increases and community growth for the first time in many years.

Population losses which characterized about 25 percent of the counties in 1961 show that in many parts of the state the farm to town movement continues, with many of the white migrants probably moving to Mississippi cities while most of the nonwhites go to cities out of the state. Interestingly, it is the counties which are peripheral to older areas of growth and somewhat isolated from the main transportation arteries which continue to lose people. More counties tend to lose nonwhites rather than whites and some of the counties, previously gaining nonwhites, are now losing them. It seems that nonwhite losses must be directly related to decreases in agricultural employment and indirectly to changes in the industrial economy which tends to slowly absorb and readily discharge nonwhite labor depending most probably on the size of the white labor force and the number of attendent service and manual jobs available.

The third type of population change in the state is the stabilization or leveling off of earlier gain or loss trends. Population growth in Hinds, Warren, and Harrison Counties, which was very high during the 1950's, seem to have leveled off in 1961. Since white population growth is occurring in most of their adjacent counties, there is again a strong suggestion that new industrial expansion tends more and more to be of a suburban nature and is scattering into the less conjested countryside around older urban centers. Counties which are leveling-off after earlier losses of whites add further weight to such a supposition. Many of these, both white and nonwhite, are also adjacent to historically growing counties and are accessible by one or more of the main highway systems. The suggestion is that the older urban areas are decreasing their drain of population from the surrounding rural counties and instead such rural counties are themselves beginning to experience some industrial and commercial development.

PROCEDURE FOR ESTIMATION OF POPULATION

The county white and nonwhite population estimates for 1961 were prepared by the Vital Rates Method. The process essentially involves estimating county vital rates and dividing these rates into recorded county vital data to get preliminary estimates of the population size which would have been necessary to produce the registered vital statistics. Two preliminary estimates, one based on births and the other on deaths, were prepared and averaged to obtain a single population estimate as of July 1, or the midpoint of the year of estimate. County population estimates based on vital rates can never be prepared until after all the vital data for a particular year is recorded and tabulated according to the county of residence.[8]

Three separate sets of estimates were prepared for Mississippi counties—for whites, nonwhites, and the total population. The estimates published here are actually the proportional division of the total county estimates between whites and nonwhites. The proportions used to divide the total estimates were derived from the separate racial estimates. The divided total estimates were selected in preference over the separate racial estimates because they yielded more conservative figures on what seems to be a radical reversal of trends. In the final analysis, however, the separate and higher estimates may be the most accurate.

As with any estimating procedure, the Vital Rates Method is based upon certain assumptions. (1) It was assumed that the number of people moving into or away from a county will be reflected in the numbers of births and deaths which can, therefore, be used as indirect measures of population size. (2) It was assumed that by averaging estimates based upon births and deaths that extreme variations would be reduced. And (3) it was assumed that county birth and death trends would not differ greatly from those of the state as a whole. For this reason, the estimated changes in county vital rates between April 1, 1960 and mid-1961 were made proportional to changes in the state rates over the same period.

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[8] For details of this method see Donald J. Bogue, "A Technique for making Extensive Population Estimates," **Journal of American Statistical Association,** 45 (June 1950), 149-163.

Table 3.—Estimated Mississippi county populations, 1961[1], and trends since 1950.

	Total				White				Nonwhite			
	Population size		Percent change		Population size		Percent change		Population size		Percent change	
County	1961 Estimate	1960 Census	1960-1961	1950-1960	1961 Estimates	1960 Census	1960-1961	1950-1960	1961 Estimate	1960 Census	1960-1961	1950-1960
State	2,212,580	2,178,141	1.6	..	1,284,660	1,257,546	2.2	5.8	927,920	920,595	0.8	— 7.0
Adams	37,520	37,730	— 0.6	17.0	18,860	19,035	— 0.9	17.8	18,660	18,695	....	16.1
Alcorn	26,120	25,282	3.3	— 6.9	22,760	21,949	3.7	—10.0	3,350	3,333	0.6	—14.6
Amite	14,920	15,573	— 4.2	—19.1	6,780	7,130	4.9	—19.2	8,130	8,443	— 3.7	—19.1
Attala	22,080	21,335	3.5	—19.9	12,620	11,789	7.0	—21.8	9,460	9,546	— 0.9	—17.5
Benton	7,980	7,723	3.4	—12.2	4,590	4,114	11.5	—16.8	3,400	3,609	— 5.9	— 6.3
Bolivar	56,950	54,464	4.6	—13.6	17,600	17,521	0.5	—11.8	39,350	36,943	6.5	—14.4
Calhoun	16,840	15,941	5.6	—13.2	12,300	11,595	6.1	—17.6	4,540	4,346	4.4	1.3
Carroll	11,770	11,177	5.3	—27.9	5,020	4,677	7.2	—29.8	6,750	6,500	3.9	—26.4
Chickasaw	16,850	16,891	.	—10.9	10,270	10,380	— 1.1	— 1.4	6,580	6,511	1.1	—22.7
Choctaw	18,320	8,423	— 1.3	—23.5	5,890	5,903	....	—23.1	2,420	2,520	— 3.9	—24.3
Claiborne	10,660	10,845	— 1.7	— 9.2	2,660	2,600	2.2	—13.6	8,010	8,245	— 2.9	— 7.7
Clarke	15,990	16,493	— 3.0	—14.8	9,710	10,001	— 2.9	—12.9	6,280	6,492	— 3.3	—17.6
Clay	19,210	18,933	1.5	6.6	8,980	9,214	— 2.6	20.3	10,230	9,719	5.3	— 3.7
Cahoma	48,980	46,212	6.0	— 6.4	16,110	14,630	10.1	6.8	32,880	31,582	4.1	—11.4
Copiah	27,320	27,051	1.0	—11.3	13,550	12,992	4.3	— 8.6	13,780	14,059	2.0	—13.7
Covington	13,690	13,637	.	—15.0	8,960	8,896	0.7	—17.8	4,730	4,741	...	— 9.1
DeSoto	24,650	23,891	3.2	— 2.9	9,730	9,248	5.2	14.5	14,920	14,643	2.0	—11.4
Forrest	56,250	52,722	6.7	17.0	40,830	37,970	7.5	18.3	15,420	14,752	4.5	13.8
Franklin	9,430	9,286	1.5	—15.0	5,580	5,486	1.8	—17.2	3,840	3,800	1.1	—11.7
George	11,480	11,098	3.4	10.8	10,230	9,811	4.3	11.7	1,250	1,287	— 3.0	4.5
Greene	8,170	8,366	— 2.3	1.8	6,340	6,443	— 1.7	— 4.0	1,830	1,923	— 4.6	27.9
Grenada	19,620	18,409	6.6	— 2.2	10,160	9,352	8.7	3.9	9,460	9,057	4.4	— 7.9
Hancock	14,760	14,039	5.1	18.1	12,440	11,784	5.5	19.6	2,330	2,255	3.1	10.6
Harrison	118,390	119,489	— 0.9	42.1	99,840	100,233	....	41.9	18,550	19,256	— 3.7	43.5
Hinds	189,840	187,045	1.5	31.6	112,440	112,205	....	43.4	77,400	74,840	3.4	17.1
Holmes	28,300	27,096	4.4	—18.6	7,620	7,595	....	—13.9	20,680	19,501	6.0	—20.3
Humphreys	19,500	19,093	2.6	—17.4	5,860	5,758	1.7	—17.9	13,730	13,335	3.0	—17.2
Issaquena	3,080	3,576	—14.0	—28.0	1,280	1,176	8.8	—27.3	1,800	2,400	—25.2	—28.3
Itawamba	14,700	15,080	— 2.6	—12.4	13,780	14,206	— 3.0	—12.7	910	874	4.2	— 6.7

Jackson	57,330	55,522	3.3	76.8	46,180	44,658	3.4	81.1	11,150	10,864	2.6	61.3
Jasper	17,340	16,909	2.6	—10.6	8,750	8,402	4.2	8.6	8,590	8,507	1.0	—12.5
Jefferson	10,640	10,142	5.0	—10.3	2,730	2,489	9.7	—13.8	7,910	7,653	3.4	—9.1
Jeff. Davis	12,940	13,540	—4.4	—12.6	5,950	6,126	—2.9	—11.1	6,990	7,414	—5.7	—13.9
Jones	60,670	59,542	1.9	4.0	44,890	44,095	1.8	4.5	15,780	15,447	2.2	—2.9
Kemper	13,000	12,277	5.9	—22.8	5,350	4,828	10.8	—25.3	7,650	7,449	2.7	—21.0
Lafayette	22,550	21,355	5.6	—6.3	15,590	14,110	10.5	—4.1	6,960	7,245	—4.0	—10.4
Lamar	14,510	13,675	6.1	3.4	12,080	11,443	5.5	2.9	2,430	2,232	9.1	6.0
Lauderdale	69,710	67,119	3.9	4.6	45,410	43,635	4.1	7.0	24,300	23,484	3.5	0.4
Lawrence	9,630	10,215	—5.7	—19.2	6,470	6,354	1.8	—19.4	3,160	3,861	—18.1	—18.9
Leake	17,960	18,660	—3.8	—13.7	10,320	10,559	—2.3	—15.2	7,640	8,101	—5.7	—11.6
Lee	41,560	40,589	2.4	6.2	31,460	30,300	3.8	9.9	10,100	10,289	—1.8	—3.5
Leflore	48,430	47,142	2.7	—9.0	18,200	16,699	9.0	1.3	30,230	30,443	—0.7	—13.8
Lincoln	27,120	26,759	1.4	—4.1	18,610	18,407	1.1	—1.6	8,510	8,352	1.9	—9.1
Lowndes	47,790	46,639	2.5	23.2	29,910	28,871	3.6	48.5	17,880	17,768	0.7	—3.5
Madison	32,770	32,904	—0.4	—2.8	9,500	9,267	2.5	3.8	23,280	23,637	—1.5	—5.2
Marion	24,540	23,293	5.3	—2.8	16,550	15,408	7.4	—1.1	7,990	7,885	1.3	—6.0
Marshall	24,250	24,503	—1.0	—2.4	7,130	7,264	—1.9	—1.5	17,130	17,239	—0.7	—2.8
Monroe	31,970	33,953	—5.8	—7.1	20,290	21,932	—7.5	—3.9	11,680	12,021	—2.8	—12.3
Montgomery	15,130	13,320	13.6	—7.9	8,350	7,349	13.6	—10.9	6,780	5,971	13.6	—4.1
Neshoba	20,220	20,927	—3.4	—18.7	14,930	15,026	—0.6	—21.2	5,290	5,901	—10.4	—11.5
Newton	21,010	19,517	7.6	—14.0	14,670	12,950	13.3	—12.7	6,340	6,567	—3.5	—16.4
Noxubee	16,730	16,826	—0.6	—16.0	5,000	4,724	5.9	—7.7	11,730	12,102	—3.1	—18.8
Oktibbeha	27,160	26,175	3.8	6.5	15,890	14,727	7.9	14.9	11,270	11,448	—1.5	—2.6
Panola	29,230	28,791	1.5	—7.9	12,660	12,565	0.8	—8.8	16,570	16,226	2.1	—7.2
Pearl River	22,350	22,411	...	8.6	17,350	17,221	0.7	6.2	5,010	5,190	—3.5	15.5
Perry	8,120	8,745	—7.2	—4.0	6,110	6,333	—3.6	—8.2	2,010	2,412	—16.7	9.1
Pike	36,290	35,063	3.5	......	20,690	19,655	5.2	1.2	15,610	15,408	1.3	—1.9
Pontotoc	18,150	17,232	5.3	—13.8	14,960	13,946	7.3	—13.8	3,190	3,286	—3.0	—13.9
Prentiss	18,500	17,949	3.0	—9.4	16,060	15,763	1.9	—9.8	2,440	2,186	11.6	—6.3
Quitman	21,510	21,019	2.4	—18.8	7,880	7,715	2.1	—24.2	13,640	13,304	2.5	—15.3
Rankin	35,460	34,322	3.3	18.8	22,590	21,504	5.1	41.4	12,860	12,818	......	—6.2
Scott	20,890	21,187	—1.4	—2.3	13,850	13,050	6.1	6.0	7,050	8,137	—13.4	—13.2
Sharkey	11,340	10,738	5.6	—16.8	3,380	3,247	4.1	—12.4	7,960	7,491	6.3	—18.5
Simpson	20,060	20,454	—1.9	—6.3	12,300	13,254	—7.2	—8.9	7,760	7,200	7.8	—1.0
Smith	14,230	14,303	—0.5	—14.6	10,980	11,056	—0.7	—17.2	3,250	3,247	......	—4.2
Stone	7,190	7,013	2.5	12.0	5,490	5,302	3.5	8.2	1,700	1,711	......	25.3
Sunflower	47,760	45,750	4.4	—18.3	16,250	14,730	10.3	—17.6	31,510	31,020	1.6	—18.7

(Continued on page 14)

Table 3.—Estimated Mississippi county populations, 1961[1], and trends since 1950. (Continued from page 13)

	Total				White				Nonwhite			
	Population size		Percent change		Population size		Percent change		Population size		Percent change	
County	1961 Estimate	1960 Census	1960-1961	1950-1960	1961 Estimates	1960 Census	1960-1961	1950-1960	1961 Estimate	1960 Census	1960-1961	1950-1960
Tallahatchie	24,390	24,081	1.3	—21.0	8,570	8,580	......	—22.5	15,820	15,501	2.1	—20.1
Tate	17,980	18,138	—0.9	0.7	7,830	7,696	1.7	0.7	10,150	10,442	— 2.8	0.7
Tippah	15,220	15,093	0.8	—13.9	12,290	12,337	....	—12.7	2,920	2,756	6.1	—18.8
Tishomingo	15,010	13,889	8.1	—10.6	14,280	13,210	8.1	—10.4	730	679	6.8	—15.8
Tunica	16,920	16,826	0.6	—22.3	4,080	3,505	16.5	—11.1	12,840	13,321	— 3.6	—24.8
Union	18,040	18,904	— 4.6	— 6.7	15,100	15,592	— 3.2	— 6.2	2,940	3,312	—11.2	— 8.9
Walthall	13,390	13,512	— 0.9	—13.2	7,370	7,412	— 0.5	—11.7	6,020	6,100	— 1.4	—14.9
Warren	41,910	42,206	— 0.7	6.5	22,270	22,447	— 0.8	15.0	19,630	19,759	— 0.6	— 1.7
Washington	78,670	78,638	.....	11.5	33,830	35,239	— 4.0	50.4	44,830	43,399	3.2	— 7.8
Wayne	16,220	16,258	— 0.3	— 4.4	10,680	10,449	2.2	— 3.2	5,530	5,809	— 4.8	— 6.6
Webster	11,180	10,580	5.6	— 8.8	7,980	7,938	0.5	—11.0	3,200	2,642	21.1	— 1.9
Wilkinson	13,160	13,235	— 0.5	— 6.2	3,660	3,807	— 3.8	—12.6	9,500	9,428	0.8	— 3.4
Winston	18,310	19,246	— 4.9	—13.4	10,140	10,853	— 6.6	—16.1	8,170	8,393	— 2.7	— 9.7
Yalobusba	12,260	12,502	— 1.9	—17.7	6,750	6,962	— 3.0	—18.4	5,510	5,540	— 0.6	—16.8
Yazoo	30,470	31,653	— 3.7	—11.4	12,320	12,862	— 4.3	— 5.6	18,150	18,791	— 3.4	—14.9

Percent not given when less than one half of one percent.

Estimates are rounded.

[1] Midyear.

SUMMARY

Population movements and changes are hard to measure and predict, but there is strong evidence in these state and county estimates, that Mississippi is beginning to develop population growth trends which are very similar to those of the whole nation. Between the April, 1960 and mid-1962, the nation averaged a 3.6 percent increase and Mississippi recorded a 3.2 percent of growth, according to Bureau of Census estimates.

In 1961, for the first time in many years, more than half of the state's counties were measured as growing in population, with most of the growth being accounted for by the white population. In fact, the size of the gain of whites is too large to be accounted for by natural increase alone. Thus, while the farm-to-town movement continues, a sizeable amount of the white movement, both from within and outside the state, seems to be draining into Mississippi's own growth centers. Nonwhites are continuing to move out of the state, but in smaller numbers than before.

The county estimates for 1961 allocate most of the population growth to counties with relatively small cities or to those adjacent to older growing urban areas. These growth patterns indicate a trend toward wider dispersal of industrial plants into less urbanized or suburban areas. The county estimates also suggest that there is a slacking-off of nonwhite movement out of agriculture.

It is too soon to judge if the new population trends recorded by these estimates are the harbingers of permanent changes in the state's community and economic structures, or only a temporary reversal in the old migration patterns which have been draining Mississippi of its human resources for nearly 100 years. They do, however, illustrate how rapidly and forcefully changing conditions can affect social trends and movements. If the apparent current trends continue, many of Mississippi's planners will be faced with a completely new challenge—that of a growing population and sizeable influxes of new people.

BULLETIN 660 FEBRUARY 1963

Weed Control In Cotton

Recommendations for 1963

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

Nomenclature of Chemicals Used as Herbicides

This list of herbicides is intended only as an aid in obtaining the chemicals. Use of trade names does not imply endorsement of a product by the Mississippi Agricultural Experiment Station, or the U. S. Department of Agriculture and such names are given only for herbicides which, at the time of release of these recommendations, are marketed only under the trade names listed.

Common name	Chemical name of active ingredient	Trade name
CIPC	isopropyl N-(3-chlorophenyl) carbamate	Chloro IPC
dalapon	2,2-dichloropropionic acid	Dowpon
DCMA	N-(3,4-dichlorophenyl) methacrylamide	Dicryl
DCPA	2,3,5,6-tetrachloroterephthalic acid	Dacthal
diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea	Karmex DL Karmex
DMA[1]	disodium monomethylarsonate	Several Mfrs.
herbicidal naphtha[2]	A petroleum naphtha — field proved, sold, and labeled specifically for use in cotton	Several Mfrs.
monuron	3-(p-chlorophenyl1)-1, 1-dimethylurea	Telvar ML
PCP	pentachlorophenol	Several Mfrs.
surfactant	Highly variable; comparative evaluation data by chemical type are very limited. Only nonionic agricultural surfactants, sold specifically for use with herbicides and cleared for use under Public Law 518, are recommended.	Several Mfrs.

[1] Also known as DSMA

[2] Also known as herbicidal oil

CAUTION

The manufacturer's label gives the number of pounds of active material per gallon of the herbicidal concentrate, or for powders, the percentage of active ingredients. Instructions on the manufacturer's label pertaining to usage and to personal hazards in handling should be read and strictly followed.

1963 WEED CONTROL RECOMMENDATIONS FOR COTTON

By J. T. HOLSTUN, JR., V. C. HARRIS, And C. E. MOORE[1]

Certain fundamental principles and detailed instructions for the control of weeds in cotton were set forth in Mississippi Agricultural Experiment Station Bulletin 612, Weed Control Handbook for Mississippi, February, 1961. The recommendations presented here supplement Bulletin 612, but are complete within themselves except for certain detailed instructions.

The control of weeds in cotton is becoming more efficient each year. It is also becoming more complex and requires thorough advance planning and supervision. Both recommendations and **tentative or trial recommendations** will be presented in order to provide growers with all information that can be justifiably released.

Recommendation of a herbicidal treatment means that extensive research and grower trials under a wide range of conditions have been completed with generally favorable results. Practices given an unrestricted recommendation are supported by data which indicate that use of the recommendation will generally be to a grower's advantage. Recommendation of a chemical practice does not mean that it will be satisfactory under all weather conditions or other adverse circumstances, but with such practices the limitations are usually known and published. Adverse results due to undiscovered limitations are certainly possible, but the probability of such failures is low.

A tentative, or trial recommendation means that the research data are encouraging enough to warrant limited use of the treatment, but that information with respect to one or more important factors is either missing or insufficient. The grower must determine for himself the extent to which a tentative recommendation is used, and he should recognize the fact that the chances of adverse results are much greater than with recommended practices.

The problem of weed control in cotton varies considerably from one field to another. A total system of weed control may be a combination of several separate practices. The various practices to be recommended will be grouped acording to time and method of application. Combination of these practices into a system of control for a particular field will be left to the individual grower, but information helpful in this respect can be obtained from County Agents and from Bulletin 612.

PREPLANTING TREATMENT

No chemical is currently recommended for preplanting treatment nor is any one cultural procedure considered vastly superior to all others. Regardless of the preplanting methods employed the end result should be a well-settled bed with enough loose soil on top to adequately cover the cotton seed. Existing weeds should be destroyed before or during planting.

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[1] Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Mississippi Agricultural Experiment Station.

The authors are Agronomist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Stoneville, Mississippi; Agronomist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, State College, Mississippi; and Assistant Extension Agronomist - Cotton, Extension Service, U. S. Department of Agriculture, State College, Mississippi, respectively.

PREEMERGENCE TREATMENT

Equipment: Preemergence treatments may be made with equipment similar to that used in applying liquid insecticides. Most 1-, 2-, and 4-row planters can be modified to apply the preemergence herbicides correctly.

Planting: Following proper seedbed preparation, hill-drop the cotton seed 10 to 22 inches apart at a rate to give 4 to 7 stalks per hill. The number of seed to plant per hill will vary according to the germination percentage. Normally, 6 to 12 seed per hill will be required. If hill-dropping cannot be used then drill plant the cotton and thin at a later date.

Cross cultivation of cotton for weed control has been practiced for a number of years in adapted situations. Chemical treatment can be used in combination with cross cultivation. The seed should be drilled at a high rate (60-90 lbs. per acre).

Where preemergence herbicides are to be used the cotton seed should be covered with at least one-half inch of soil. Research results have shown no advantage in preemergence weed control obtained by using a wide roller instead of the regular planter press wheel. **However, if postemergence treatments are to follow preemergence applications a wide flat press wheel will give a better shaped seedbed for the later operations and should be used.**

Placement of Herbicides: The chemical is sprayed on the soil behind the planter press wheel. The nozzle should be located to the rear of the planter press wheel or extra roller at the proper position to spray a 12-inch band centered on the drill.

Replanting: Adverse weather sometimes makes it necessary to replant cotton, including that which has received preemergence treatment. Replanting may be done in several ways. The field conditions should indicate which system of replanting to use. **Retreatment with any known preemergence herbicide, however, is not recommended.**

Herbicides to use: CIPC or diuron is recommended for preemergence use on sandy loam to clay loam soils for control of most small seeded annual weeds. No preemergence herbicide is recommended for extremely sandy soils. Monuron is recommended for control of small seeded annual weeds in heavy clays such as Sharkey and Houston. No preemergence herbicides are recommended for control of perennial weeds. Both diuron and monuron are available as liquid suspensions and as wettable powders. The liquid formulations are recommended for preemergence use.

One new preemergence herbicide, DC PA, is **tentatively recommended** for control of small-seeded annual weeds in sandy loams to silt loams.

Rates of Herbicides: Recommended rates for each herbicide are presented in Tables 1 and 2. Within a given soil texture the lower side of the rate-range should be used on soils low in organic matter of general fertility. In fields consisting of more than one soil type the field should either be divided into smaller fields of the same type of soil; or if the area of the secondary soil type or types is insignificant in size, the rate should be selected the major soil type.

POSTEMERGENCE TREATMENTS

Cultural Treatments:

Weeds in the Middles: Generally it is recommended that weeds in the middles be controlled by cultivation unless some type of broadcast herbicide treatment eliminates the need for cultivation. A new flame applicator is **tentatively recommended** for flaming row middles where con-

Table 1.—Recommended rates and mixing data for preemergence herbicides in cotton where a 12-inch wide band is treated at the rate of 12 gallons per 13068 row-feet.[1]

Herbicide	Lb. active ingredient per gallon	Soil texture	Rate - lb. active ingredient recommended for 13068 row-feet of 12-inch band			Pints of chemical needed for 50 gallons of spray mixture where volume of spray application is 12 gallons per 13068 row-feet of 12-inch band.[1] (Corresponds with rates presented at left)		
			Minimum	Intermediate	Maximum	Minimum	Intermediate	Maximum
			lb.	lb.	lb.	pints	pints	pints
CIPC	4.0	Medium sandy loam	1.2	1.4	1.8	10.0	12.0	15.0
CIPC	4.0	Very fine sandy loam	1.8	2.2	2.4	15.0	18.0	20.0
CIPC	4.0	Silt loam	2.1	2.4	2.7	17.5	20.0	22.5
CIPC	4.0	Clay loam	2.4	3.0	3.6	20.0	25.0	30.0
Diuron	2.8	Medium sandy loam	.14	.17	.20	1.68	2.00	2.40
Diuron	2.8	Very fine sandy loam	.20	.25	.28	2.40	3.00	3.35
Diuron	2.8	Silt loam	.28	.34	.37	3.35	4.00	4.43
Diuron	2.8	Clay loam	.37	.42	.50	4.43	5.00	5.99
Monuron	2.8	Clay	.50	.50	.50	5.99	5.99	5.99

[1] 13068 row-feet = 1.05 acres if row width is 42 inches, 1.00 acre if width is 40 inches, 0.95 acre if width is 38 inches, and 0.90 acre if width is 36 inches. Calibrate sprayer to deliver 1 quart per nozzle in the same number of seconds it takes the sprayer to travel 272 feet. If this is done, row width can be ignored in calibration

Table 2.—Rates tentatively recommended for preemergence DCPA in cotton where a 12-inch wide band is treated at the rate of 12 gallons per 13068 row-feet.

Soil texture	Rate-lb. active ingredient recommended for 13068 row-feet of 12-inch band[1].		
	Minimum	Intermediate	Maximum
Medium sandy loam	1.2	1.4	1.8
Very fine sandy loam	1.8	2.2	2.4
Silt loam	2.1	2.4	2.7
Clay loam	2.4	3.0	3.6

[1] 13068 row-feet = 1.05 acres if row width is 42 inches, 1.00 acre if width is 40 inches, 0.95 acre if width is 38 inches, and 0.90 acre if width is 36 inches. Calibrate sprayer to deliver 1 quart per nozzle in the same number of seconds it takes the sprayer to travel 272 feet. If this is done, row width can be ignored in calibration.

trol is needed and there is reason for avoiding cultivation. Plans for building the new middle flamer may be obtained from the Cotton Mechanization Project, Delta Branch Experiment Station, Stoneville, Mississippi.

Conventional cultivation and shielded cultivation: Conventional cultivation consists of the use of sweeps or other implements to throw soil into the drill area to smother young weeds and to plow up weeds growing in the middles. Shielded cultivation is similar except that shields or special implements are used to prevent movement of soil into the drill area. **Shielded cultivation should be used** if the control of weeds by previous chemical or flame treatment is completely effective, if further directed sprays are to be applied, or if immediate flaming is planned. **Conventional cultivation should be used** when neither postemergence herbicides nor flame can be used, and the control of weeds is not essentially complete.

Cross cultivation: Cross cultivation is the practice of drill-planting cotton at a heavy rate and cultivating both with and across the rows to obtain the desired stand and more effective weed control. Cross cultivation should be restricted generally to soils lighter than clays, and to relatively level fields where its use does not cause an erosion problem. Only good unbroken stands of cotton prior to cross cultivation are acceptable. The number of cotton plants left is determined by the width of the space between the sweeps, disk-hillers or other tools used in the cross cultivation. Final stands of 6 to 8 stalks per hill are satisfactory where cross cultivation is at the standard row width (38-42 inch centers). Because second and later cross cultivation may plow out additional plants, the first crossing should leave a few more plants than are needed for the final stand.

Cross cultivation can be effectively combined with pre- and post-emergence herbicides. Shield sweeps, disk-hillers, and other similar implements are recommended for the first crossing. If postemergence naphtha is used it must be applied before the first cross cultivation. As a general rule there will be time for only one naphtha application with cross cultivation. Flame cultivation is an excellent tool to use in conjunction with cross cultivation.

Flaming: A flat type burner which uses butane, propane, or a mixture of the two is recommended. Mississippi Agricultural Experiment Station Bulletin 545 should be consulted for detailed information concerning flamers and the method of setting the burners.

As a general suggestion the grower should go to the field with the machine late in the afternoon or at night when the flame pattern will be visible. Visibility of the pattern will make accurate setting of the machine much easier. It is also a good idea to flame a few rows one day in advance of a general flaming. Appearance of the flamed cotton and weeds the next day may suggest changes needed to increase weed control or reduce damage to the cotton.

Flame treatments may be started when the cotton is about 10-12 inches tall and the stems are at least 3/16 inch in diameter. The field should be free of large weeds when flaming is started because flame is much more effective on small succulent weeds than on large, well established weeds. Flame should be reapplied often enough to prevent weeds from growing beyond seedling stages.

Chemical Treatments:

Herbicidal Naphthas: Only naphthas which have been proved satisfactory in field tests for selective weed control in cotton should be used. No fortifying agent should be present, and these recommendations are restricted to unfortified naphthas that are sold specifically for weed control in cotton after successful field trials.

In relatively level fields where herbicidal naphthas are to be used the seedbeds should be low and flat on top after planting. **At least 16 inches centered over the drill** should be level, smooth, free of clods, press-wheel marks, and other obstructions.

Four nozzles (with fan-type orifices) per row should be used. These should be positioned as shown in Figure 1. Nozzle pair "A" should be tilted down no more than enough to keep the naphtha from setting outside the 10-inch band centered on the drill-row. This angle will normally be about 3 degrees below horizontal. Naphtha from nozzle pair "B" does not contact the cotton, and the rate of application from nozzle pair "B" should be high enough to insure good control at the edges of the treated band; this is accomplished by using orifices in nozzle pair "B" that deliver 1½ to 2 times as much

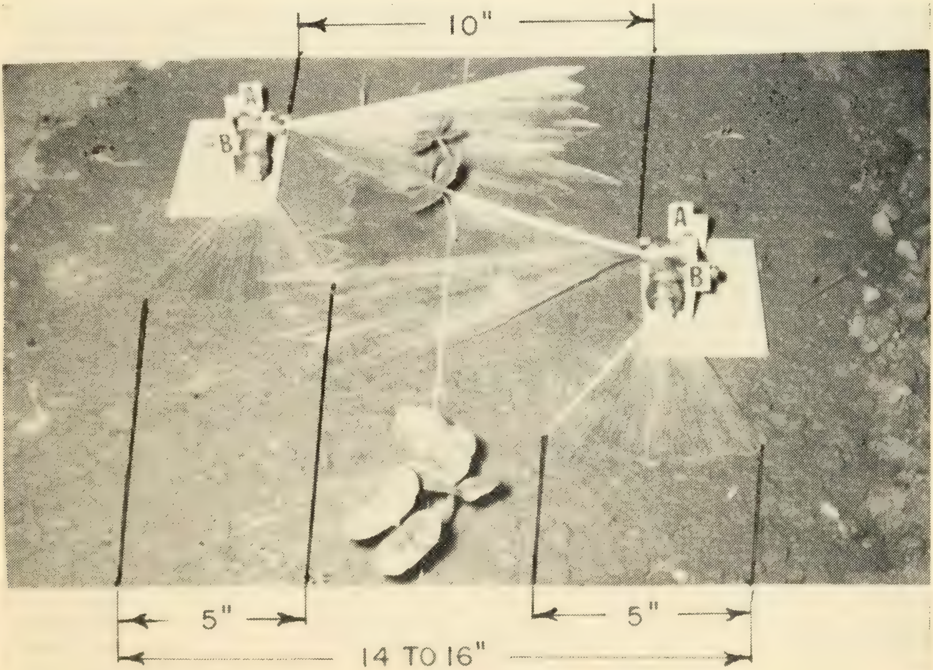

Figure 1. Nozzle setting for spraying herbicidal naphtha. Front nozzles (A) are spraying across the row, while rear nozzles (B) are spraying rearward and down. Produces 12 to 14 inches of satisfactory coverage.

naphtha as the orifices of nozzle pair "A".

In contoured fields (markedly sloping) it is more difficult to prepare proper seedbeds for use of herbicidal naphthas. In such cases the nozzles may be set in special ways to fit the row.

The importance of keeping the naphtha on the lowest inch of the cotton stem cannot be over-stressed. Naphtha applied high on the stem, on the bud, or on the leaves will injure or kill young cotton plants.

When the cotton seedlings have been out of the soil for 7 to 10 days (at least 2 inches tall) the first application of herbicidal naphtha may be made, if needed. The first naphtha application is needed, and should be made, when weeds make their first appearance in the treated drill area. If the cotton has been out of the soil for less than 3 weeks, from 4 to 7 gallons per acre (band basis) of naphtha may be applied from nozzle pair "A" for the first application, depending on the amount of weed growth. Since the naphtha from nozzle pair "B" does not contact the cotton, the rate of application is not as critical as with nozzle pair "A" (therefore, calibrate nozzle pair "A" accurately and set rate of application from nozzle pair "B" by using orifices rated at 1½ to 2 times the capacity of nozzle pair "A").

Simplicity and efficiency of the first naphtha application can be greatly increased by making it **before any cultivation.** In fact two applications before cultivating may be practical if weeds in the middles are not too large.

After the cotton has been out of the ground for 3 weeks, or after the first application, no more than 5 gallons per acre should be applied at any one time from nozzle pair "A".

Herbicidal naphtha is effective on small weeds only (less than 1 or 2 inches in height), except for nutsedge or very succulent grasses. It kills only those weeds which it contacts. Where a preemergence herbicide has been used there may be some tendency to delay the first application of herbicidal naphtha. This is a mistake except in the comparatively few cases where control by the preemergence herbicide is essentially perfect. The best overall results have been obtained by establishing 100 percent control of weeds as soon as possible after emergence of the cotton.

A total of two applications, and in cases of extreme weediness even three applications, of herbicidal naphtha can be made provided certain restrictions are followed. Applications: (1) should be at least 5 days apart; (2) should be made only to cotton which is healthy; (3) should not be made when the soil is too wet to cultivate unless the air temperature is below 85 degrees; and (4) should not be made after the bark begins to form or small bark cracks begin to appear at the base of the cotton stem. Do not apply postemergence naphtha to cotton showing appreciable injury from preemergence herbicides, previous naphtha applications, hail, disease, or other factors.

Diuron: Diuron is recommended for two types of postemergence control of small-seeded annual weeds in cotton.

First, diuron at a low rate plus surfactant is recommended as a directed spray for contact control of young, actively-growing small-seeded annual weeds after the cotton is at least 6 inches tall. Diuron at a broadcast rate of 0.2 lb/A plus 0.5 percent surfactant appears effective and safe. A mixture of 0.2 pound active diuron plus 1 pint of surfactant diluted to 25 gallons with water should be used. For band spraying 2 nozzles per row, as shown in Figure 2, should be used to apply 0.6 gal/A of the mixture for each inch of band width sprayed (where rows are 40 inches wide). For broadcast spraying 4 nozzles per row, as shown in Figure 3, should be used to apply 25 gallons/A of the mixture. For best results the mixture should be applied before weeds reach a height greater than 2 inches. A second and third application may be made if necessary. Good results should not be expected if the weeds are drought-stressed at time of treatment.

Second, as a combined contact-residual spray for control of mid- and late-season small-seeded annual weeds (layby usage), diuron appears safe and effective on a qualified and restricted basis. The recommendation must be qualified because the economic value of the practice has not been established. The recommendation must be restricted to situations in which late season weeds can be expected and in which the practice can be expected to be effective. The effect of the practice of using a lay-by herbicide on the grade of hand- or machine-picked cotton has not been accurately evaluated in the Mid-South area.

Lay-by treatment may be accomplished by use of split applications or by a single application. Where diuron postemergence treatments are used, care must be taken to see that the total yearly rates presented in Table 3 are not exceeded regardless of whether one or several applications are made (including pre- and postemergence band or broadcast treatments made in the early part of the season.)

Where perennial weeds such as redvine, nutsedge, and Johnsongrass are not present the split-application technique is recommended. Recommended pre- and postemergence band treatments and cultivation should be used during the initial period of the season. As soon as the cotton reaches a height of 10 inches apply a mixture of diuron plus surfactant as a directed broadcast spray (Figure 3) at the rate indicated in Table 3. Thereafter, cultivate only if weeds get out of control.

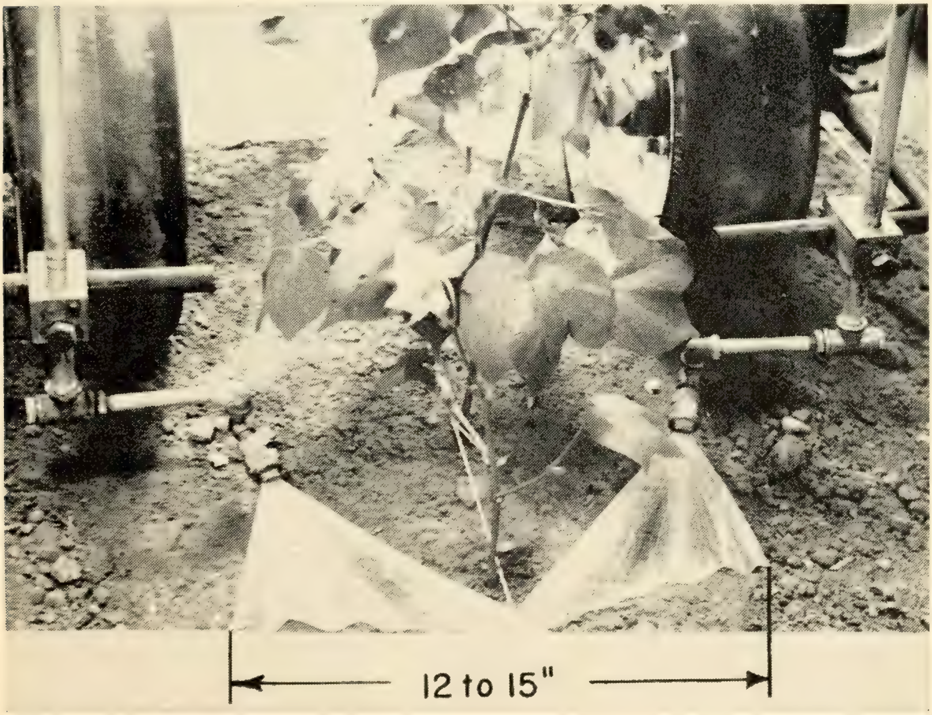

Figure 2. Down-and-back nozzle setting for applying aqueous-mixed herbicides in a band.

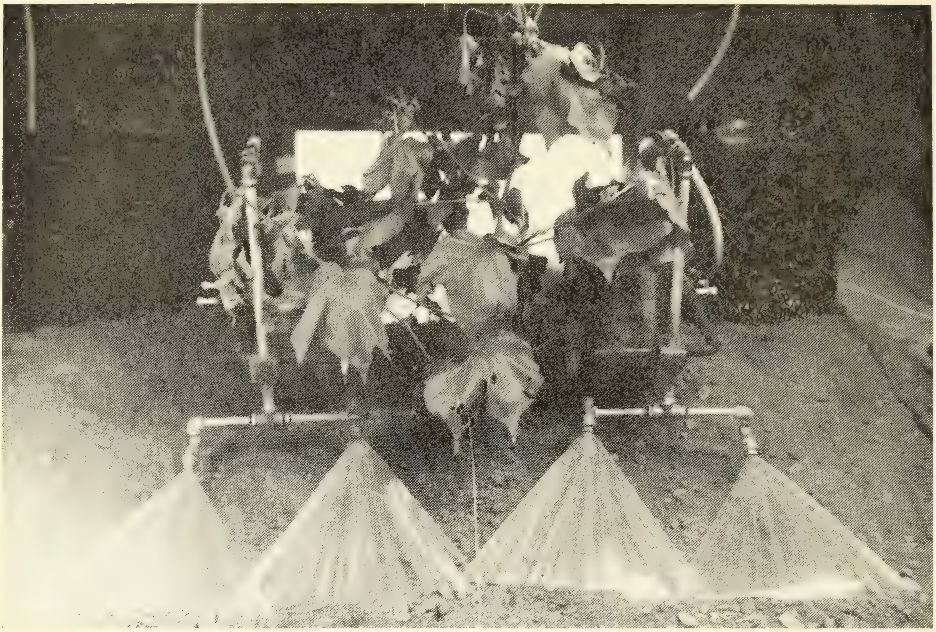

Figure 3. Four-nozzle arrangement for broadcast applications.

Retreat at the same rate before the cotton limbs develop to the point at which they would interfere with spray application.

Nutsedge, established Johnsongrass, redvine, and other perennial weeds are not satisfactorily controlled by postemergence diuron plus surfactant. Where perennial weeds are present the split application of diuron is not recommended since cultivation and flaming should be continued well past the time at which cotton reaches a height of 10 inches. In such fields it is recommended that cultivation, postemergence band treatments, flaming, and hoeing be continued until one or two weeks before the lower limbs of the cotton develop to the point at which they would interfere with a directed spray-application. At this time a single application of diuron and surfactant may be made as

Table 3.—Rates of diuron plus surfactant for lay-by treatment for various soil textures.

	Pints of surfactant per	Lb/A of active diuron (broadcast basis)[1]		Maximum amount of active diuron recommended per
Soil texture	100 gal. of spray (both types)	Split application (each time)	Single application	year (total lb/A for all types of usage)[1]
Coarse sandy loam loamy sand or sand		Do not treat	Do not treat	0.00
Medium sandy loam	4	.20 to .30	.47 to .70	0.90
Very fine sandy loam	3	.30 to .40	.70 to .93	1.25
Silt loam	3	40 to .60	.93 to 1.24	1.60
Clay loam	3	60 to .75	1.24 to 1.60	1.60
Clay	3	.75	1.60	1.60

[1] Because of possible hazards from residual toxicity and restrictions under Public Law 518, the total amount of diuron used per acre in one crop season should not exceed the total listed in the last column above. Therefore, where pre- or postemergence band or broadcast treatments have been used previously in the season it may be necessary to reduce lay-by rates to avoid exceeding the recommended yearly total.

a directed broadcast spray for contact and residual control of annual weeds. The spray, as in the split-application techniques, should cover the soil evenly and not contact the cotton higher than about 2 inches up the stalk (see Table 3 for rates of application and Figure 3 for nozzle setting). Contact action of postemergence diuron appears more dependent on weather conditions before rather than after application. Small, fast growing weeds are susceptible; drought-stressed weeds are resistant. Formerly drought-stressed weeds, even large ones, become very susceptible for a period of 1 to 3 days after initial drought-ending rain.

Residual action of postemergence diuron inhibits establishment of germinating weeds as competing plants. Soil moisture after diuron application must reach a high level by irrigation or rainfall within 10 days after application for good residual control. Diuron wettable powder is more economical than the liquid formulation, and is satisfactory for all postemergence applications. A small amount of special preparation will have to be given to the spray equipment to insure adequate agitation of the powder.

Lay-by treatments with diuron should be made only where the following crop is to be **cotton, corn, or sorghum.**

Bulletin 612 (pages 16-18) should be consulted for other considerations before using lay-by applications of diuron.

DCMA plus DMA: A mixture of DCMA is **tentatively recommended** for postemergence use after the cotton is **at least 3 inches tall,** but **not after boll formation.** A mixture of 1 pound active DCMA and 2 lb. active DMA (a quantity equivalent to 2 pounds of anhydrous disodium monomethylarsonate) diluted to 40 gallons with water should be applied as a directed spray at 12 gallons per acre where a 12-inch band on rows 40 inches wide is treated (use 1 gal/A for each inch of band sprayed). Nozzles may be set as in Figure 1 or with two nozzles per row as shown in Figure 2.

For best results the mixture should be applied before weeds reach a height greater than 2 inches. A second application may be used where needed. Although the mixture is recommended for control of young, small-seeded annual weeds. promising results have also been obtained in some experiments on nutsedge, cocklebur, and Johnsongrass.

SPOT TREATMENTS

Spot treatments are recommended for use in cotton where the weed infestation covers 5 percent or less of the drill area. Although this type of control is directed primarily toward control of Johnsongrass, it can be used on other weeds occuring as spot infestations. Prospective users of spot treatments are cautioned that the economics have not been thoroughly evaluated.

Naphthas, diesel fuel containing 0.25 percent PCP, and dalapon solution (3.7 pounds dalapon and 1 pint of surfactant diluted to 25 gallons with water) are recommended as spot treatment herbicides. (Dalapon is not recommended for control of broadleaf weeds.) Spot treatment should be made before the Johnsongrass or other weeds get more than 12 inches high. Retreatment should be done as needed.

BULLETIN 661 FEBRUARY 1963

Recommendations for 1963

Weed Control In Soybeans

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Nomenclature of Chemicals Used as Herbicides

This list of herbicides is intended only as an aid in obtaining the chemicals. Use of trade names does not imply endorsement of a product by the Mississippi Agricultural Experiment Station or the United States Department of Agriculture, and such names are given only for herbicides which at the time of release of these recommendations, are marketed under the trade names listed only.

Common Name	Chemical name of active ingredient	Trade Name
Amiben	3-amino-2,5-dichlorobenzoic acid	Amiben
Dalapon	2,2-dichloropropionic acid	Dowpon
Linuron	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	Lorox
NPA	N-1-naphthylphthalamic acid	Alanap
herbicidal naphtha	A petroleum naphtha sold for use in soybeans or cotton	Several Mfrs.
4-(2,4-DB)	4-(2,4-dichlorophenoxy) butyric acid	Butoxone SB Butyrac 118 Butyrac 175
surfactant	Highly variable; comparative evaluation data by chemical type are very limited. Only nonionic agricultural surfactants sold specifically for use with herbicides are recommended.	Several Mfrs.

CAUTION

The manufacturer's label gives the number of pounds of active material per gallon of the herbicidal concentrate, or for powders, the percentage of active ingredients. Instructions on the manufacturer's label pertaining to usage and to personal hazards in handling should be read and strictly observed.

WEED CONTROL RECOMMENDATIONS FOR SOYBEANS IN 1963

By C. G. McWHORTER, V. C. HARRIS, and J. W. McKIE[1]

The weed problem in soybeans may develop in early season, late season or may develop progressively throughout the season. Goosegrass, crabgrass, brachiaria, pigweed, and other small-seeded weeds usually constitute the early-season problem. Cocklebur and morningglory often develop in late season and greatly lower combine efficiency. Johnsongrass competes with soybeans throughout the growing season, lowers yields, reduces quality, and often causes substantial delays in harvesting. Since soybeans are planted in late spring or early summer, preplanting control measures may be used for Johnsongrass control that would not be suitable for use in certain other crops.

PREPLANTING METHODS OF WEED CONTROL

Johnsongrass

An application of dalapon as a postemergence foliage treatment on emerged Johnsongrass prior to planting soybeans or repeated preplanting cultivation is recommended for the control of established Johnsongrass in fields to be planted to soybeans. Neither of these practices will provide 100 percent control nor will they provide control of Johnsongrass seedlings which germinate after soybeans are planted. If either of these preplanting weed control practices are used a suitable preemergence herbicide should be applied after the soybeans are planted and before they emerge to aid in the control of seedling Johnsongrass to prevent reinfestation.

Combination chemical-Minimum Cultivation method. Dalapon should be applied at 3.7 to 5.5 lbs/A as a preplanting broadcast foliage spray to actively growing Johnsongrass at least 3 weeks prior to planting soybeans. Increased control will be obtained if a surfactant is added to the spray mixture at the rate of one half pint of surfactant per 50 gallons of total spray. Dalapon should be applied broadcast only to areas heavily infested with Johnsongrass.

Fields with spot-infestations can be sprayed with hand or conventional tractor equipment. Johnsongrass treated with a foilage application of dalapon should be disked 4 to 7 days after herbicide application so as to remove all above-ground plant growth. If the soil is hard and packed when this disking is applied so that the soil is poorly mixed and the Johnsongrass only partly cut, the disking should be repeated. It is important that the soil be thoroughly mixed. Soybeans should not be planted until 2½ weeks after this disking. Johnsongrass that emerges during the 2½ weeks period between disking and soybean planting should be removed by additional disking or by cultivation with overlapping flat sweeps be-

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fore the Johnsongrass plants reach "boot" stage.

Dalapon applied as a postemergence foliage spray to emerged Johnsongrass prior to planting soybeans will normally provide sufficient Johnsongrass control to result in increased soybean yields that will produce a larger net profit. When this treatment is used for the first time a small untreated area adjacent to the treatment area should be compared to determine the success and value of the treatment.

Dalapon applied preplanting as recommended will usually give less residual late-season control of Johnsongrass than will the intensive cultivation method described below. The use of the dalapon treatment however is not as dependent on long periods of limited rainfall for success nor does the use of dalapon tie up equipment for long periods as does the intensive cultivation method.

Cultural, Intensive Cultivation Method: Johnsongrass can also be controlled with 6 to 10 fallow-cultivations prior to planting soybeans. A diskharrow appears to be slightly more effective than a field cultivator for Johnsongrass control. Alternate usage of the two implements is equally effective as disking alone and will be more economical than use of a disk for all cultivations. Six to 10 cultivations at 4 to 8 day intervals should be applied in a 4 to 6 week period prior to planting.

If excessive rainfall prevents the application of these treatments at uniform intervals throughout the 4 to 6 week period, disk cultivations should be applied twice to the same field on the same day and repeated whenever possible until a total of 6 to 10 cultivations are applied.

The number of cultivations necessary for a given level of control will depend on the severity of the Johnsongrass infestation and the level of soil mositure present during the preplanting period. Since relatively dry soil conditions are necessary for optimum control using intensive cultivation, dalapon used as previously described will be more effective for Johnsongrass control under prolonged wet periods. Eight or 10 diskings will probably provide a longer period of good control than will the dalapon treatment but intensive cultivation requires the use of large amounts of farm machinery on a relatively strict schedule.

There does not appear to be an economic advantage from use of both dalapon and intensive fallow-cultivation preplanting. Either one or the other should be used but not both on the same field.

Annual Weed Control

Since soybeans are planted in late spring or early summer, shallow preplanting cultivation may be used as a means of controlling one or more crops of early weeds. Very shallow disking, plowing, use of harrows or rotary hoes or tillers should destroy the weeds and form a shallow mulch. Where annual weeds such as crabgrass, Brachiaria, goosegrass, pigweed, and annual morningglory present early-season weed problems the use of herbicides may be warranted. Pre- and postemergence treatments are recommended for controlling these weeds.

PREEMERGENCE METHODS OF WEED CONTROL

Amiben is recommended for use on soils having textures of medium sandy loam to clay. NPA is recommended on soils having textures of medium sandy loam to clay loam. Linuron[2] is a new preemergence herbicide which is recommended for trial use on soybeans grown for seed purposes only. This herbicide has been very promising in experimental work for 2 years and is recommended only for trial use on soils having textures of medium sandy loam to clay. Since linuron is a new herbicide it should be applied only to as much acreage as the farmer is willing to have injured by the herbicide. Rates of amiben, linuron, and NPA are presented in Table 1.

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[2] As of January 1, 1963 label restrictions under Public Law 518 restrict the use of linuron to soybeans grown for seed purposes.

None of these herbicides should be applied preemergence to soybeans on light textured sandy soils. Regardless of the soil type the soybean seed should be covered at least one inch deep but additional protection will be obtained against possible herbicide injury if the seed are planted deeper. Soybean injury may be obtained with any of the recommended herbicides and particularly with NPA. In most instances soybean injury from these preemergence herbicides probably will not reduce crop yields if the recommended rates are applied to the proper soil type. Reduced weed control and some complete failures can be expected if the herbicides are applied to dry soil and 1 to 2 or more weeks elapse before rainfall occurs.

Amiben and linuron will generally provide better preemergence control of most weeds but especially of seedling Johnsongrass and cocklebur than NPA. If the primary weed problem is caused by cocklebur and seedling Johnsongrass the recommended rates listed in Table 1 should be increased 25 percent. It should be realized that even these increased preemergence rates will not provide perfect control of weeds such as cocklebur which can germinate and emerge from a depth of 4 inches or deeper.

Table 1.—Rates of amiben, linuron, and NPA for preemergence weed control in soybeans.

	lb/A on 12-inch band[1]		
Soil texture	Amiben	Linuron	NPA
Medium sandy loams	0.6	0.3	0.6
Very fine sandy loams	0.8	0.5	0.9
Silt loams	0.9	0.6	1.2
Clay loams	1.1	0.8	1.8
Clay	1.3	1.0	...

[1] Applied only where rows are 40 inches wide.

POSTEMERGENCE METHODS OF WEED CONTROL

Cultural Methods

Conventional Cultivation of Weeds in Row Middles: This long used practice needs little explanation. It consists of the use of sweeps to throw soil into the drill area for the purpose of smothering young weeds. **It should not be used** if the control of weeds by a previous chemical is essentially complete, nor if the use of further postemergence oil is planned. If, however, oil cannot be used, and the control of weeds is not essentially complete, "dirting cultivation" **should be used.** "Dirting cultivation," where properly used, is usually beneficial rather than deterimental to a chemical weed-control program. Failure to "dirt" or delaying "dirting" when it is needed is as deterimental to a successful program as is "dirting" when it is not needed. Care should be taken to avoid deep cultivation (which will prune the roots of the soybeans), and even shallow cultivation should be used no more often than necessary for weed control.

Rotary Hoeing: A rotary hoe may be used as soon as soybeans are up to a stand and repeated as needed at about 5-day intervals. Rotary hoeing is most effective when weeds are breaking through a slightly crusted soil but will give very little control if the soil is damp or wet. Rotary hoeing is generally a highly economical practice in terms of the weed control obtained as compared to the investment.

When soybeans are in the first trifolium (one pair of true leaves) or second trifolium leaf stage (two pair of true leaves) the rotary hoe should be used after the plants have lost some of their turgidity (slightly wilted). This usually occurs in late morning or near noon. Some weed control may be obtained from rotary hoeing soybeans in the third trifolium although weeds are generally too large and too well rooted to be effectively controlled at this stage of growth. Yield reductions may be obtained if soybeans are rotary hoed after the third trifolium is fully expanded.

Chemical Methods

Herbicidal oils: A single directional application of herbicidal oil at 5 gallons per acre 12 to 16 days after soybean emergence and when weeds are 1 to 3 inches tall has been effective in controlling early season weeds. Under no conditions should the rate of 5 gallons per acre be exceeded or the oil applied at other stages of soybean or weed growth. Only naphtha type oils which have been proved satisfactory by research on selective weed control in cotton should be used. No fortifying agent should be present, and these recommendations are restricted to unfortified naphthas that are sold specifically for weed control in cotton or soybeans after successful field research and use.

In relatively level fields where herbicidal oils are to be used the seedbeds should be low and flat on top after planting. Rotary hoes should not be used prior to the application of herbicidal oil since their use makes the row surface very rough. At least 16 inches centered over the drill should be level, smooth, free of clods, presswheel marks, and other obstructions.

Normally two nozzles per row are used. One nozzle should be used on each side of the row and each nozzle should be 5 inches from the drill center. The two nozzles should be spaced and directed so as to prevent the two spray patterns from meeting head-on, as this might cause an objectionable deflection of the spray. Nozzles should be set so that the spray fan is horizontal and strikes the young soybean stem no higher than 1 inch from the ground level and gives adequite coverage of the weeds. The nozzles should be set so that they are 1 inch or less above the soil.

A slight downward tilt may be given to the nozzles to increase the ease of keeping oil off the soybean leaves. If the downward tilt is excessive most of the oil will be undesirably concentrated on the ground at the base of the soybean stems and the band treated will be too narrow. The oil should settle in the 8- to 10-inch band centering on the drill.

Although two nozzles per row can be used successfully, the use of an additional pair set to spray the shoulder of the row will increase the ease of the operation. The additional oil needed for these two nozzles will, however, double the per-acre cost of the oil. These nozzles should be set to spray parallel to the row and the pattern should extend slightly (2 to 2½ inches) into both the area to be cultivated and the area being sprayed by the other pair of nozzles.

The importance of keeping the oil on the lowest inch of the soybean stem cannot be over-stressed. Oil applied high on the stem, on the bud, or on the leaves will seriously injure or kill young soybean plants.

Farmers having used herbicidal oil for

weed control in cotton will experience little difficulty in applying herbicidal oil to soybeans. Anyone who wants to use this practice in soybeans and does not have previous experience with oiling should proceed with caution and apply herbicidal oil only to a limited acreage the first year.

Phenoxy Herbicides

Cocklebur can be controlled in soybeans with amine salt formulations of 4-(2,4-DB). This material should be applied as a broadcast postemergence spray over the crop at a rate of 0.2 pounds per acre in a total volume of 10 to 20 gallons of water per acre. Treatments can be applied from two weeks prior to early soybean bloom until mid bloom. Best cocklebur control is obtained if 4-(2,4-DB) is applied after cocklebur plants have elongated and are equally as tall as the soybean plants or taller. This usually occurs before early soybean bloom.

Yield reductions from 4-(2,4-DB) may occur if the herbicide is applied to soybeans after early bloom that are not heavily infested with cocklebur. If cocklebur occurs in small spotted infestations throughout a field these areas should be treated on a spot basis and the herbicide not applied to cocklebur-free soybeans. Spot treatments may be made with either hand spray equipment or with a conventional tractor-mounted-boom sprayer, cutting the spray off when traveling over uninfested areas. An effort should be made to apply 4-(2,4-DB) to fields thinly infested with cocklebur at least 7 to 10 days prior to early bloom.

If soybeans are planted during the first two weeks in May, Hill soybeans will normally be expected to start blooming the first week in July, Lee soybeans the second week in July, and Jackson soybeans will normally bloom the third week in July. If Lee or Jackson soybeans are planted in the first ten days of June they will normally start blooming the first week of August.

If the cocklebur infestation is heavy and these weeds form a canopy over the soybeans the date of application of 4-(2,4-DB) is not as critical since the weeds will prevent most of the sprays from reaching the soybeans. Generally as the level of cocklebur infestation increases the soybean injury obtained decreases

Farmers who use 4-(2,4-DB) for the first time should realize that this herbicide causes injury to soybeans but injury symptoms (pronounced stem curvature drooping leaves) generally disappear within one week after treatment. Injury is usually more severe if the chemical is applied to soybeans growing in very dry soil. Little or no control of weed species such as morningglory, pigweed, and coffeebean will be obtained from the recommended rate of 4-(2,4-DB).

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Influence Of
Repeated Use For Cooking On Some Changes In Composition Of Frying Fats

By

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INFLUENCE OF REPEATED USE FOR COOKING ON SOME CHANGES IN COMPOSITION OF FRYING FATS

By ANN R. STASCH and LOIS KILGORE

Heating of fats during their use for frying causes changes in their composition. During normal use of a fat these changes are slight, but overheating or overlong use of a fat may cause drastic changes. During commercial manufacturing processes involving frying, the changes found in fats appear to be very slight in comparison with those occurring during the use of fats under ordinary home kitchen conditions. One reason for this is the larger volume of fat used. Another reason is the rapid turnover of fat during continuous commercial operation. In the home kitchen the volume of food cooked in fat is small, the fat is used only at irregular intervals and temperature control may not be exact. Although fats and oils should not be abused during use, no evidence has been presented to show that occasional use of drastically heated fats has any damaging effects on health.

Previous work in this laboratory has shown some changes taking place in fats which had been heated for various periods of time in metal and non-metal containers, but in which no food had been cooked. This study was undertaken to determine similar changes in the composition of fats when successive batches of either chicken or potatoes were fried under various conditions simulating those found in ordinary home kitchens.

REVIEW OF THE LITERATURE

Commercially Used Fats and Oils

Changes in composition of oils used for the commercial production of potato chips have been investigated by Melnick (36) and Melnick et al. (37). Small increases in carbonyl compounds and free fatty acids were found to occur in such oils along with slight increases in the conjugated dienoic acid content, but no significant increase in trans-fatty acids was noted. Both linoleic acid content and iodine values of the oils decreased during use. Although decreases in iodine values found in corn, cottonseed and hydrogenated oils were statistically significant, they amounted to only about one per cent and were, therefore, assumed to be of no nutritional significance. This assumption was based on the work of Lassen et al. (28), comparing digestibility of unsaturated oils with increasing degree of polymerization, represented by a drop in iodine value. A drop in iodine value of at least five per cent was found to be necessary before a measurable decrease in the coefficient of digestibility occurred. In general, the composition of oils after their use in potato chip manufacture was found to be very similar to that of fresh, unheated oil. One explanation given for the small change in composition is a rapid turnover of the oil due to continual replenishment with fresh oil. Another factor which may be important here is volatilization of water from the potato slices during cooking, resulting in a steam deodorization and refining process while the fat is being used.

Samples of used fats, obtained from restaurants, bakeries and potato chip producers, have been studied by Rice et al. (43) and Poling et al. (41) to determine nutritive value. Fats subjected to even the most severe usage showed only slight decreases in caloric availability to rats. Slight increases in liver size of the rats were noted, also. The conclusion reached by these workers was that conditions of commercial usage of fats do not result in serious heat damage, although serious damage may occur in fats heated under arbitrarily chosen laboratory conditions. Keane et al. (24) showed that, whereas oil heated in the laboratory had a lowered caloric availability to rats, the same oil heated under conditions of commercial use did not change in caloric availability.

Chalmers (9) compared laboratory and commercially used oils and found a higher free fatty acid content, but lower peroxide values, in the commercially heated oil. Change in iodine value was less in the commercially heated oil, also. The difference was explained as being due to a greater volume of fat in the commercial fryer, resulting in relatively less surface exposure of the oil. Rice et al. (44) have also noted that change in amount of fat heated per unit of surface area has a greater influence than temperature on change in composition of a frying fat.

Laboratory Experiments on Heated Fats

Fats and oils have been heated in the laboratory under various conditions to determine the degree of severity of change. With care, laboratory data may be used to interpret changes which might be expected to occur under conditions of actual use.

Kritchevsky et al. (27) studied the hydrolysis of triglycerides to release free fatty acids during short-term heating experiments conducted on various fats. The temperature of the fat was maintained at 235 ± 5° C. Samples were titrated for free fatty acids after 20, 40, 60, 90 and 120 minutes. The extent of hydrolysis varied widely among the various fats used. For example, olive oil did not change at all, whereas the free fatty acid content of coconut oil increased 180 fold. However, very little change was noted in any fat until after at least one hour of heating. No apparent correlation was found between the initial and final free fatty acid content of the fats, but the amount of hydrolysis was closely related to temperature, duration of heating and water content of the fat.

The importance of water in breakdown of fats had been noted previously by Porter et al (42). When water was dripped continuously into a fat during heating, a much larger increase in free fatty acids occurred than when the fat was simply heated. Bito and Yamamoto (8) reported that the accelerated oxidation of a fat which results from frying foods of high water content was especially notable at lower temperatures. The water formed during autoxidation itself may be an important factor here, also (25).

Although hydrolysis of a fat is regarded as a sign of degradation, Hall et al. (19) showed that this reaction is related also to development of flavor in fried foods. The initial development of free fatty acids during deep fat frying of potatoes was accompanied by an increased flavor score on the cooked potatoes. The flavor of french-fried potatoes reached a maximum rating after 16 frying periods, when the acid number of the fat reached approximately 5.5. After this time, a rapid increase in fat acidity occurred, along with a rapid decline in the desirability of the fat flavor. Each of the 16 frying periods consisted of three hours of preheating at 93° C, 15 minutes to raise the temperature of the fat to 185° C, and two hours at 185° C, followed by another 2 3/4 hours at 93° C. The free fatty acid content of the potatoes was assumed to be even higher than that of the frying fat, since carboxyl groups would be preferentially absorbed.

King et al. (26) had demonstrated previously that the free fatty acid content of fat extracted from fried potatoes was, indeed, higher than that of the frying fat. Increases were noted in levels of free fatty acids and peroxides, while iodine values decreased, in various lards, cottonseed, corn and peanut oils used to fry successive batches of potatoes. All fats were heated to 185° C in five quart iron kettles. A decrease in general quality of the potato chips occurred as the number of fryings increased.

As a test of flavor during successive frying, Goodman and Block (18) fried two lots of doughnuts—one in fresh oil, and the other in the same oil after it had been used in a continuous frying kettle at a doughnut bakery. One of each of these doughnuts was fed to 100 people. Thirty-eight preferred the doughnut fried in fresh fat, 40 preferred the doughnut fried in commercial fryer fat, and 22 had no preference.

Chang et al. (10) periodically analyzed samples of lard in which doughnuts were cooked and corn oil in which potato chips were cooked. The iodine values of both fats were found to decrease with increased use, while the amount of conjugated dienoic acid increased. In corn oil, the amount of linoleic acid decreased, but the amount of linolenic acid increased, with increased use of the fat. The peroxide value of lard increased rapidly and then decreased to a negligible value, indicating that peroxide destruction occurs more rapidly than peroxide formation at 180° C. Although the peroxide content of lard increased during overnight storage, heating again lowered these values to negligible levels.

Rice et al. (44) fried five pounds of potato chips twice a day in refined cottonseed oil at 182° C. After two days use (48 hours), the fat was foaming violently. Potato chips, cooked in the fat while it was foaming, were fed to rats at a level to supply 20 per cent of fat in the diet. Weight gains of these rats were smaller than those of rats fed the same amount of fresh fat. A continuous decrease in caloric availability of the heated cottonseed oil to rats was noted in the fat after each day of use, up to 120 hours. However, the same fat, heated for 120 hours with no potatoes fried in it, had an even lower caloric availability than that in which potatoes were fried. The onset of foaming in fats is, therefore, related to the beginning of biological changes in rats. Goodman and Block (18) showed that the time of appearance of foaming in commercial fats varied between 10 and 21 hours of heating at 375° F.

Color changes in fats, mainly toward the development of reds and yellows, occurred during their use. Such changes are affected by the kind of food cooked. Bennion and Hanning (6) have found that the frying of a fritter-type batter produced a greater degree of darkening than the frying of french-fried potatoes. Color changes in fats do not affect flavor, but they give an undesirable appearance to the fat.

Hydrogenated cottonseed oil, which had been used for 80 hours at 190° C for deep fat frying, was distilled by Kaunitz et al. (23), who then fed the distillate to rats. The net energy value of this diet was found to be lower than that of a diet containing distillate from fresh oil.

Aside from lowered caloric value of heated fats, other biological effects have been noted. Recently, Nishida et al. (39) fed heated corn oil to chickens at a level of 15 per cent in the diet. This diet depressed serum cholesterol and beta-lipoprotein levels, but did not appear to affect the incidence of atherosclerosis.

Home Cooking Processes

Custot (15) reviewed some of the changes in heated fats from the standpoint of the hazards involved in poorly controlled frying of foods. In experiments where peanut oil was used for 30 successive fryings, changes in the fat were found to be much more severe under household use than under laboratory conditions. Tests showed that polymerization had occurred in the oil used under ordinary home kitchen conditions, but not in the laboratory used oil. The greater change in oil used under household conditions was attributed to poor control of frying conditions, including temperature. Further study of changes occurring in fats used in the home seems warranted, as this situation exemplifies the fact that laboratory obtained data may not be used directly to interpret changes occurring under other conditions.

The nutritional value of fats in meats cooked under simulated home conditions has been studied by Warner et al. (48). Conventional household equipment was used, but the meats were slightly overcooked to exaggerate any change occurring. Fats extracted from the cooked meats were fed to rats. Cooked pork from ham, bacon or spareribs promoted better weight gain in rats than fresh fat did. However, rats receiving fat from cooked lamb, beef or poultry gained less weight than control rats fed fresh fat. These workers concluded that the conditions needed to produce a palatable product in home kitchens are such as to minimize opportunities for decreased nutritive value of a fat. Onset of foaming and color change, as well as production of off-flavors in the cooked product, act as safeguards against overlong use of a fat.

The nutritive value of fat in cooked foods is related to the amount of essential fatty acids present, as well as to caloric availability. Essential fatty acids are highly unsaturated and, therefore, susceptible to oxidation at temperatures used in meat cookery. Chang and Watts (11) studied the change in essential fatty acid content of some meats and poultry during cooking. Of all meats cooked roast chicken was the only one which did not show a loss in total unsaturation during cooking. The loss in unsaturation exceeded two per cent in the case of roast pork loin and leg of lamb, both of which showed considerable peroxide formation during cooking. Losses in oleic acid were mainly responsible for the overall loss in unsaturated fatty acids. Linolenic and arachidonic acids were present in very small amounts (fractions of one per cent) even in the fresh fat.

Chicken fried in vegetable oil, and cooked bacon, contained the largest amounts of linoleic acid, whereas beef and lamb contained the smallest amounts of this acid. In general, these workers concluded that the fatty acid content of meats and poultry is not changed substantially by cooking.

Some Factors Affecting the Stability of Fats

Fats recovered from fried or roasted meats have been shown to have good resistance to oxidation, although they are highly colored and have a strong odor and flavor (29). Stabilization of oils has been accomplished by heating them at either atmospheric or reduced pressure with a sugar plus various other substances, such as proteins, amino acids, and aromatic or aliphatic acids. Increased keeping quality has been claimed for certain fats heated with spice residues, finely divided peanut or soybean flour, molasses and irradiated yeast. Butter oil kept better when the whole butter had been heated at 205° C or when the butter oil had been heated with skim milk powder at 205° C. The storage life of lard has been increased by heating it under vacuum to 288-296° C with 0.1 to 0.5 per cent of various protein and carbohydrate materials, of which dried whey was the most effective. Although an undesirable color and odor were produced in the lard by this process, bleaching and deodorizing to a bland, light-colored product resulted in a loss of most of the added stability.

The frying of vegetables rich in vitamin C has been shown to be effective in retarding the oxidation of frying oils, as has the addition of salt (8). Mabrouk and Dugan (32) have shown, however, that the effect of salt is not direct, but decreases the amount of oxygen available for reaction. Coe's work (12) showed that light in the blue end of the spectrum and the presence of metallic catalysts, like iron, both hastened the onset of rancidity.

Marcuse (33, 34, 35) studied the effects of various amino acids on autoxidation. Alanine, histidine, cysteine, tryptophan, methionine, glycine, proline, serine, lysine, asparagine, valine, phenylalanine, arginine and threonine were all shown to have a potential antioxidative activity. The antioxidative effect was pH dependent, with cysteine showing a strong pro-oxidative tendency under certain conditions. Saunders et al. (45) showed that the presence of histidine, at certain pH values, greatly enhanced the pro-oxidative effect of ionic iron. Histidine, combined with ionic iron, may exert a pro-oxidative effect when it is involved in hydroperoxide decomposition, and an antioxidative effect when it is involved in chain termination. Becker et al. (5) reported that proteins inactivate oxidation promoting metals below pH 5 but not between pH 5 and 7. The metal inactivating effect of proteins accounts for at least a part of the stabilizing effect which occurs when fats are heated with protein containing materials.

The rate of oxidation of a fat, which increases with increasing unsaturation of the fat, can be markedly accelerated by the presence of copper or iron at concentrations of one part per million or less. As Lundberg (30) has pointed out, acceleration of oxidation by metals is extremely important in regard to the problem of rancidity in food. Certain iron-containing biologic substances, such as cytochrome C and hemoglobin, were noted by Lundberg (31) to be effective catalysts of lipid oxidation, also.

Evans et al. (16) studied the effect of trace metals on the flavor stability of soybean oil. In commercial fats, flavor stability values did not correlate with metal content of the fat because of the addition of metal deactivators during processing. Iron is a high temperature catalyst and is very detrimental at deodorization temperatures (210° C). The temperature of deep fat frying (180°-190° C) is sufficiently close to deodorization temerature for iron frying pans to exert a catalytic effect on oxidation. In soybean oil, iron catalyzed the formation of high peroxide levels, but other metallic catalysts did not show this effect. Previous work in this laboratory (47) showed that heating fats in iron frying pans resulted in an increase in the amount of total carbonyl compounds present. Harada et al. (20) showed that the action of iron from a container used for heating was minimized by the presence of an oxidized film of oil on the surface of the container.

The effects of both iron and aluminum containers on cottonseed oil used to fry potato chips were investigated by Chalmers (9). The oils were used for a total of seven hours heating time. Both free fatty acid content and peroxide values were found to be higher in cottonseed oil heated in the iron vessel, but iodine values decreased to a greater extent in the oil heated in the aluminum vessel.

MATERIALS AND METHODS

This study was divided into two parts. In Part 1 successive batches of chicken or potatoes were fried in four kinds of fat in both iron and glass ceramic frying pans. Neither the fat absorbed by the food cooked, nor the fat lost due to sampling were replaced. Therefore, the volume of fat used for frying decreased during each successive frying period. In Part 2 chicken was fried in two kinds of fat in both iron and glass ceramic frying pans. Fresh fat was added at the beginning of each frying period to replace that absorbed by the food and that lost by sampling. Therefore, a constant volume of fat was maintained throughout all frying periods.

Part 1. Repeated Use of the Same Frying Fat

A. Successive fryings of potatoes in various fats.

Preparation of fats. Four kinds of fat were used — a lard, a cottonseed oil, a hydrogenated vegetable shortening and a hydrogenated animal-vegetable combination shortening. All fats were purchased from shelf supplies at local markets. A homogeneous mixture was made from 21 pounds of each fat. Cotton seed oil was mixed without warming. All the other fats, which were solid at room temperature, were heated just enough to liquefy them, and were mixed in the liquid state. The same amount of each of the fats, approximately 2.4 pounds, was used in each frying pan.

Frying pans. Eight frying pans were used with each of the above fats—four of cast iron and four of glass ceramic composition. The experiment was run as two replicates, each consisting of two cast iron and two glass ceramic frying pans. In each replicate, one pan of each kind, called the scoured pan, was scoured with steel wool and cleanser after each use. The other pans, called unscoured pans, were wiped with paper toweling after every second hour of use, instead of being scoured. Since the fat in each pan was heated twice each day, that in the unscoured pans was allowed to remain in the frying pan between the first and second heating each day.

Potatoes. Idaho potatoes were purpurchased in 100 pound lots at a local market. After peeling, the potatoes were cut by hand into strips of approximately ¼ by ½ inch. Although the length of the strips varied with the size of the potato, this dimension was generally four to six inches. The potato strips were weighed into one pound lots which were placed in two approximately equal portions on enamelled trays. Each portion was fried separately.

Frying periods. The fats were heated on a conventional, four burner, electric kitchen range. Into each pan a thermometer was placed, serving both as a stirrer and as a means of measuring temperature. Temperature in each pan was controlled by adjustment of burner heat controls. Time required for the fat in each pan to reach a temperature of 180° C was not recorded. Each frying period consisted of one hour, beginning when the temperature of the fat first reached 180° C. For 10 minutes after timing began the temperature of each fat was maintained at 185° ± 5° C. Then, one-half of the potato slices were fried for 12 minutes. During much of this time, the temperature of the fat was below 180° C, although by the end of 12 minutes, the fat had regained a temperature of 185° ± 5° C. This temperature was maintained for another 10 minutes, after which the second half of the potato strips were fried for 12 minutes. After removal of the second batch of potatoes from the frying pan, the temperature of the fat was maintained for an additional 16 minutes. The frying pan was then removed from the range and placed on an asbestos mat, where the fat was allowed to cool under an air draft. Two frying periods were conducted each day with each fat. After the second heating each day, all fats were poured into glass beakers, cooled to room temperature and stored, uncovered, overnight at 9° C.

Sampling. A sample of the original homogeneous mixture of each fat was saved for analysis. Fat samples, removed from each frying pan after the fifth and tenth frying periods, were stored in brown bottles at 9° C until they were analyzed. A composite sample of fried potatoes was collected from those fried in all pans during the fifth and the tenth frying periods. The potato samples were stored in plastic freezer bags at -20° C until they were analyzed.

Analyses. All fat samples were analyzed, in duplicate, for peroxide values (4), total carbonyl compounds (22), Hanus iodine values (2), free fatty acids (3), and **in vitro** hydrolysis by pancreatic lipase (21). Total fat was extracted from the potato sample after it had been ground in a food chopper (1). Some of this fat was analyzed subsequently for iodine values by the above method. All data were analyzed statistically by analysis of variance.

B. Successive fryings of chicken in various fats.

Preparation of fat. The fat mixtures were prepared in the same manner as above, using different lots of each fat.

Frying pans. Frying pans were set up in the same way as above, with one exception. The residue from the fried chicken showed such a tendency to stick to the pans, that the method of wiping out pans with paper toweling was not satisfactory. Therefore, the "scoured" frying pans were scoured with steel wool and cleanser after each frying period, whereas the "unscoured" pans were scoured after every other frying period.

Chickens. Chickens were purchased from the Poultry Department at the Mississippi Agricultural Experiment Station. All chickens which were to be fried in any one kind of fat were obtained from the same lot. The birds were sawed in half while frozen and the two halves packaged together. After thawing, each half chicken was cut up into the usual frying pieces—wing, leg, thigh, breast and back pieces. No breading or flouring of any sort was used in preparing the chicken for frying, nor was salt added to them.

Frying periods. The temperature of each fat was raised to 180° C exactly as in Part 1. Ten minutes after the temperature of the fat in each pan reached 180° C, one-half of a chicken was fried for 30 minutes. The opposite half of each of the chickens was fried in the corresponding pan in the replicate experiment. After the chicken was removed, the temperature of the fat was maintained at 185° ± 5° C for an additional 20 minutes before the frying pan was removed from the range.

Sampling and analyses were conducted in exactly the same manner as in Part 1 A.

Part 2. Repeated Use of Frying Fat with Periodic Addition of Fresh Fat

Preparation of fat. Lard and cottonseed oil, purchased from the shelf supplies in a local market, were used in this part of the study. Homogeneous mixtures of the fats were prepared as in Part 1. Nine hundred and fifty grams of each fat was placed in each frying pan initially. A sufficient quantity of each fat was prepared so that the weight of fat in each pan could be maintained at 950 grams throughout the experiment.

Frying pans. The experiment was replicated, each replicate consisting of one iron and one glass ceramic frying pan. All the pans were scoured with steel wool and cleanser after each frying period.

Chickens. Whole, frozen chickens were purchased from one lot raised by the Poultry Department of the Experiment Station. After thawing, the chickens were cut up into the same frying pieces as before, except for the back. The back was divided into breast and rear portions, one of which was fried with each half of the chicken. The pieces from each chicken half were prepared for frying by shaking them in a paper bag containing one-half cup of enriched, all-purpose flour and one-half teaspoon of salt.

Frying periods. As before, the temperature of the fat in each pan was raised to 180° C. and maintained at 185° ± 5° for 10 minutes, before the chicken was placed in the pan. Half of each chicken was fried in an iron pan and its opposite half was fried in a glass ceramic pan. The chicken was fried for 24 minutes, removed, and the fat maintained at 185° ± 5° C for 21 minutes. Another half chicken was then fried for 24 minutes, removed, and the fat temperature maintained for an additional 11 minutes before the pan was removed from the burner. Each frying period, therefore, consisted of a total of 90 minutes.

After removal from the range, the fat from each frying pan was poured into a glass beaker and the pans were cleaned. The fats were cooled almost to room temperature and stored overnight at 9° C. The weight of fat in each pan was made up to 950 grams at the beginning of each frying period with fat from the original homogeneous mixture. The procedure was repeated five times, making a total heating time of 7.5 hours.

Sampling. A sample of each fat was taken from the unheated, homogeneous fat mixtures and from each frying pan at the end of each frying period. Fat samples were stored in brown bottles, under nitrogen, at -20° C until analyzed. A sample of chicken, comprising the breast, leg, thigh and wing portions, was taken from each batch of chicken fried in each pan. All chicken samples were stored in plastic freezer bags, under nitrogen, at -20° C until analyzed.

Analyses. Fat samples were analyzed, in duplicate, for iodine values and free fatty acids. All methods of analysis were the same as those used in Part 1.

Chicken samples were thawed. All meat and skin was cut from the bones, which were discarded. The chicken was ground once through a coarse cutter plate and twice through a fine cutter plate of an electric food grinder. The material was thoroughly mixed after each grinding. The ground chicken was dried for 6 hours at 100° C in a forced draft oven, after which fat was extracted. Some of this extracted fat was analyzed immediately for free fatty acids. The rest of the fat was stored in small vials, under nitrogen, at -20° C until it could be analyzed for iodine values and **in vitro** hydrolysis by pancreatic lipase.

All data was analyzed statistically, using analysis of variance procedures.

RESULTS AND DISCUSSION

Results obtained from both parts of this study are reported together, since, in many cases, the discussion involves a comparison between both sets of data. Some qualitative observations of the physical characteristics of the fats during use are reported because changes in appearance of a fat can be observed easily by a homemaker in her own kitchen. All data was tested by analysis of variance to determine statistical significance. Tables of F values are given in the Appendix. These tables, and further tests for significance among the various treatment means, when necessary, were used in making the interpretations of the data discussed herein.

Color Changes

All of the fats darkened slightly during the first frying period. The change in color was always more pronounced when fats were heated in iron frying pans, although intensity of the color increased in all fats with increased length of time of use. When floured chicken was fried in fat maintained at a constant volume, color changes were not as pronounced.

Foaming

Both kind of food fried and kind of fat in which it is fried were found to affect the length of time a fat can be used before onset of foaming. When potatoes were fried in cottonseed oil, a slight foam occurred after four hours of use. After seven hours of use, foaming in this fat was so severe that extreme caution was necessary when raw potatoes were added to avoid overflow of foam from the pan. The other fats in which potatoes were fried — lard, hydrogenated vegetable shortening and hydrogenated animal-vegetable combination shortening—began to foam slightly after six hours of use and were foaming violently after nine hours of use.

When chicken was fried in these same kinds of fat, none of them began to foam until after nine hours of use. Even then, foaming was not severe. No foaming was evident in either lard or cottonseed oil used 7.5 hours to fry floured chicken when a constant volume of fat was maintained. Flouring of chicken, therefore, does not hasten the onset of foaming in fats.

Onset of foaming occurred in these fats sooner than it has been reported to occur in commercially used fats. Since conventional kitchen frying pans were used in these studies, the volume of fat was less than that found in a commercial fryer. Other factors influence onset of foaming however, since it occurs at variable times even during commercial use.

Proteins are known to stabilize fat during heating. The fact that onset of foaming occurred more rapidly when fats were used to fry potatoes than when they were used to fry chicken may be explained, in part, on the basis of the respective protein contents of these two foods. According to Watt and Merrill (49), chicken contains approximately ten times as much protein as potatoes do.

Other factors are important in fat stability, also. Foods with high water content hasten degradation of a fat. The water content of potatoes (77.8%) is slightly higher than that of chicken (74.7%).

Compositional Changes

1. Peroxide values. Results obtained from analysis of peroxide values on the various fats used to fry both chicken and potatoes are given in Table 1. Peroxide values of all fats heated in glass ceramic pans were higher after potatoes were fried, whereas peroxide values of fats heated in iron pans were higher after chicken was fried. Maximum rates of oxidation are reported to occur in fats heated in metal containers at high temperatures for long periods of time, such as occur during frying (46). Iron is known to be a high temperature catalyst of fat oxidation and has been reported to catalyze peroxide formation, in particular. Hemoglobin present in the drip or "weep" fluid from the cut up chicken pieces might be expected to hasten the process of oxidation in fats. "The "weep" fluid also contained other protein or amino acid constituents. As Bishov et al. (7) have pointed out, the presence of proteins nullifies the catalytic effect of hemoglobin.

The fact that these results do not show that all fats heated in iron pans have higher peroxide values may be of little actual significance. Since peroxides are destroyed as rapidly as they are formed at frying temperatures, any analysis of peroxide values in a fat represents only the situation present at the time of analysis. Even though peroxides are produced in the fat during cooling, the same catalytic effects may not be operative at this time.

2. Free fatty acids. The free fatty acids found in the four fats used to fry chicken and potatoes are reported in Table 2. Significant increases in free fatty acids occurred in all fats with increased length of time of use. Fats in which chicken was fried contained lower amounts of free fatty acids than fats in which potatoes were fried. Potatoes, therefore, caused hydrolysis of fats to occur at a greater rate than chicken.

When chicken was fried, the kind of frying pan used had no effect on free fatty acid content of any of the fats. The greatest production of free fatty acids occurred in lard, and the least in cottonseed oil.

When potatoes were fried some interaction occurred between the kind of fat and the kind of frying pan used. In this case, use of scoured iron pans resulted in the production of a high free fatty

Table 1.—Peroxide values of various fats before and after frying successive batches of chicken or potatoes.

Food fried:	Chicken			Potatoes		
Frying pan / Hours fat used:	0	5	10	0	5	10
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
			Cottonseed oil			
Scoured iron	1.55	3.99	4.79	0.97	4.34	8.29
Scoured glass ceramic	1.55	4.00	5.37	0.97	4.73	8.03
Unscoured iron	1.55	5.07	5.31	0.97	1.95	6.41
Unscoured glass ceramic	1.55	6.18	5.49	0.97	1.06	7.08
			Lard			
Scoured iron	1.20	5.28	4.36	5.27	4.24	4.87
Scoured glass ceramic	1.20	7.77	2.15	5.27	8.76	3.65
Unscoured iron	1.20	6.39	6.05	5.27	5.64	4.45
Unscoured glass ceramic	1.20	9.07	2.58	5.27	6.52	7.70
			Hydrogenated vegetable shortening			
Scoured iron	0.36	4.66	4.90	0.27	4.62	2.98
Scoured glass ceramic	0.36	4.37	6.70	0.27	7.14	7.82
Unscoured iron	0.36	4.72	3.99	0.27	6.59	1.46
Unscoured glass ceramic	0.36	5.95	4.93	0.27	6.79	6.98
			Hydrogenated animal-vegetable combination shortening			
Scoured iron	0.45	7.03	7.09	0.53	5.67	1.69
Scoured glass ceramic	0.45	11.07	9.00	0.53	7.66	6.37
Uncoured iron	0.45	9.36	9.04	0.53	7.65	1.25
Unscoured glass ceramic	0.45	10.93	9.62	0.53	8.05	6.23

Table 2.—Free fatty acid[1] content of various fats before and after successive batches of chicken or potatoes.

Food fried:	Chicken			Potatoes		
Frying pan / Hours fat used:	0	5	10	0	5	10
	%	%	%	%	%	%
			Cottonseed oil			
Scoured iron	0.04	0.26	0.50	0.05	0.18	0.56
Scoured glass ceramic	0.04	0.28	0.53	0.05	0.20	0.40
Unscoured iron	0.04	0.40	0.50	0.05	0.20	0.44
Unscoured glass ceramic	0.04	0.29	0.47	0.05	0.20	0.40
			Lard			
Scoured iron	0.42	0.64	0.89	0.40	0.68	0.98
Scoured glass ceramic	0.42	0.67	0.93	0.40	0.66	1.24
Unscoured iron	0.42	0.66	0.66	0.40	0.62	1.16
Unscoured glass ceramic	0.42	0.64	0.96	0.40	0.66	1.22
			Hydrogenated vegetable shortening			
Scoured iron	0.20	0.42	0.75	0.17	0.36	0.70
Scoured glass ceramic	0.20	0.37	0.72	0.17	0.42	0.84
Unscoured iron	0.20	0.38	0.88	0.17	0.38	0.86
Unscoured glass ceramic	0.20	0.40	0.60	0.17	0.44	0.76
			Hydrogenated animal-vegetable combination shortening			
Scoured iron	0.12	0.37	0.85	0.09	0.42	0.98
Scoured glass ceramic	0.12	0.41	0.76	0.09	0.45	1.02
Unscoured iron	0.12	0.38	0.71	0.09	0.44	1.02
Unscoured glass ceramic	0.12	0.36	0.73	0.09	0.44	1.00

[1] Calculated as oleic acid.

acid content in cottonseed oil and a low free fatty acid content in lard.

The free fatty acids found in both the fat from the frying pans and in the fat extracted from floured chicken fried in lard or cottonseed oil, maintained at constant volume, are given in Table 3. A comparison of the data in Tables 2 and 3 shows that the addition of fresh fat each time a fat is used results in a much lower production of free fatty acids. The fact that the chicken was floured in this

Table 3.—Free fatty acid[1] content of lard and cottonseed oil and of fat extracted from chicken fried in each.

Times fat used	Fat: Frying pan:	Cotttonseed oil Iron	Cotttonseed oil Glass ceramic	Chicken fat Iron	Chicken fat Glass ceramic	Lard Iron	Lard Glass ceramic	Chicken fat Iron	Chicken fat Glass ceramic
0		0.06	0.06	......	......	0.34	0.34	......	......
1		......	......	1.32	1.22	......	......	1.05	1.22
2		0.14	0.13	1.10	0.98	0.40	0.40	1.22	1.83
3		......	......	0.91	1.34	......	......	1.07	1.02
4		0.18	0.16	1.11	0.83	0.44	0.44	1.68	2.20
5		......	......	1.14	1.12	......	......	1.41	1.64
6		0.25	0.22	1.08	1.30	0.46	0.49	1.61	1.02
7		......	......	1.07	1.09	......	......	0.89	1.01
8		0.28	0.25	1.28	1.19	0.57	0.52	1.69	2.42
9		......	......	1.34	1.02	......	......	1.14	1.02
10		0.28	0.23	1.40	1.03	0.55	0.54	0.88	1.30

[1] Calculated as oleic acid.

Table 4.—Total carbonyl compounds[1] in various fats before and after frying successive batches of chicken or potatoes.

Frying pan	Food fried: Hours fat used:	Chicken 0	Chicken 5	Chicken 10	Potatoes 0	Potatoes 5	Potatoes 10
		%	%	%	%	%	%
				Cottonseed oil			
Scoured iron		0.00	0.40	1.02	0.01	0.36	0.60
Scoured glass ceramic		0.00	0.62	1.00	0.01	0.36	0.49
Unscoured iron		0.00	0.74	1.11	0.01	0.36	0.70
Unscoured glass ceramic		0.00	0.84	0.98	0.01	0.42	0.46
				Lard			
Scoured iron		0.01	0.46	0.55	0.04	0.36	0.32
Scoured glass ceramic		0.01	0.58	0.53	0.04	0.28	0.23
Unscoured iron		0.01	0.48	0.54	0.04	0.28	0.19
Unscoured glass ceramic		0.01	0.42	0.50	0.04	0.26	0.14
				Hydrogenated vegetable shortening			
Scoured iron		0.00	0.36	0.55	0.00	0.30	0.53
Scoured glass ceramic		0.00	0.52	0.66	0.00	0.22	0.36
Unscoured iron		0.00	0.47	0.44	0.00	0.23	0.41
Unscoured glass ceramic		0.00	0.54	0.44	0.00	0.19	0.44
				Hydrogenated animal-vegetable combination shortening			
Scoured iron		0.17	0.37	0.74	0.02	0.30	0.44
Scoured glass ceramic		0.17	0.40	0.45	0.02	0.22	0.37
Unscoured iron		0.17	0.41	0.55	0.02	0.30	0.36
Unscoured glass ceramic		0.17	0.42	0.50	0.02	0.28	0.36

[1] Calculated as n — heptaldehyde.

case may also have exerted a stabilizing effect on the frying fat.

The fat extracted from the fried chicken is found to contain much larger amounts of free fatty acids than the fat in the pan. The content of free fatty acids in the chicken fat averaged 5.6 times the free fatty acid content of cottonseed oil from the pan and 3.3 times that of lard from the pan. A significant correlation (r=.51) was found between the free fatty acid contents of the pan fat and fat extracted from the chickens. Since lard originally contained much more free fatty acids, use of lard resulted in a significantly larger amount of free fatty acids in chicken fat than that which was found when cottonseed oil was used.

Kind of frying pan used had no effect on free fatty acid content of fat in the chicken when cottonseed oil was the frying medium. However, chicken fried in lard contained more free fatty acids when glass ceramic rather than iron pans were used. This difference cannot be due to differences in chickens, as halves of the same chickens were fried in glass ceramic and iron pans.

3. **Carbonyl compounds.** Amounts of total carbonyl compounds found in the various fats used to fry chicken and potatoes are shown in Table 4. Total carbonyl compounds increased in all fats as the length of time of use increased. After ten hours of use, cottonseed oil contained larger amounts of carbonyl compounds than any of the other fats, regardless of whether they had been used to fry chicken or potatoes. Kind of frying pan did not affect production of total carbonyl compounds when chicken was fried. However, when potatoes were fried, all fats heated in scoured iron pans contained significantly higher amounts of carbonyl compounds (one per cent level) than those heated in any of the other pans.

According to Farmer (17), metals promote decomposition of peroxides to carbonyl groups. Piper et al. (41) reported that iron acts as a decarboxylation catalyst to promote formation of aliphatic ketones from free fatty acids. Obviously

Table 5.—Iodine values (Hanus) of various fats before and after frying successive batches of chicken or potatoes.

	Food fried:	Chicken		Potatoes		
Frying pan	Hours fat used: 0	5	10	0	5	10
			Cottonseed oil			
Scoured iron	91.4	87.4	68.1	81.0	74.5	71.0
Scoured glass ceramic	91.4	81.1	72.6	81.0	76.4	74.9
Unscoured iron	91.4	83.0	75.3	81.0	73.9	74.7
Unscoured glass ceramic	91.4	87.2	83.0	81.0	83.6	75.9
			Lard			
Scoured iron	43.6	55.2	53.3	54.9	49.6	49.4
Scoured glass ceramic	43.6	53.3	51.6	54.9	49.0	48.4
Unscoured iron	43.6	53.2	49.2	54.9	49.4	47.6
Unscoured glass ceramic	43.6	52.6	49.8	54.9	49.1	45.4
			Hydrogenated vegetable shortening			
Scoured iron	69.8	71.5	67.4	59.7	57.2	50.4
Scoured glass ceramic	69.8	69.3	67.1	59.7	59.0	52.3
Unscoured iron	69.8	69.7	68.2	59.7	55.2	51.8
Unscoured glass ceramic	69.8	68.8	66.9	59.7	56.4	54.7
			Hydrogenated animal-vegetable combination shortening			
Scoured iron	55.3	56.2	55.3	48.8	48.1	37.4
Scoured glass ceramic	55.3	55.6	54.8	48.8	47.2	39.3
Unscoured iron	55.3	57.5	55.1	48.8	47.8	40.4
Uncoured glass ceramic	55.3	53.9	55.0	48.8	47.2	44.5

Table 6.—Iodine values (Hanus) of lard and cottonseed oil and of fat extracted from chicken fried in each.

Fat:	Cottonseed oil				Lard			
Hours fat used	Pan fat		Chicken fat		Pan fat		Chicken fat	
Frying pan:	Iron	Glass ceramic	Iron	Glass ceramic	Iron	Glass ceramic	Iron	Glass ceramic
0.00	90.3	90.3	...	...	48.2	48.2	...	...
0.75	...	...	87.5	85.9	...	...	61.1	61.7
1.50	88.6	87.6	84.3	88.4	48.1	47.9	59.4	44.6
2.25	...	...	89.4	90.1	...	...	59.5	56.5
3.00	87.9	86.3	83.4	85.7	47.9	47.9	55.5	51.2
3.75	...	...	86.6	89.2	...	...	62.6	61.4
4.50	87.2	86.8	87.9	83.6	47.9	48.3	67.6	59.4
5.25	...	...	89.1	88.5	...	...	64.3	61.3
6.00	85.1	86.0	82.7	82.5	47.6	46.5	53.9	54.2
6.75	...	...	82.2	88.4	...	...	61.2	62.7
7.50	85.2	83.3	84.5	89.2	48.0	47.6	67.3	59.6

the iron frying pan exerts a catalytic effect on production of carbonyl compounds in frying fats. The fact that scoured iron pans did not produce larger amounts of carbonyl compounds when chicken was fried is believed to be due to the greater protein content of the chicken. Cooney et al. (13) have reported that heating of fats promotes stability by releasing metallic ions from a complex so that they can react with metal inactivating agents. The metal inactivating effect of the protein would complement that of other metal inactivating agents naturally present or added to the fat during processing.

No catalytic effect on production of carbonyl compounds occurred in fats heated in unscoured metal pans because the metal surface of the pan was covered, in this case, by a layer of oxidized fat.

Possible implications for flavor development in fats as a result of the presence of larger amounts of total carbonyl compounds have been discussed in a previous publication (47).

4. Iodine values. Iodine values of fats before and after frying chicken or potatoes are given in Table 5. When potatoes were fried, all fats except lard showed a significant decrease in iodine value with increased length of time of use. The iodine value of lard decreased significantly during the first five hours of use, but showed no further change during the next five hours. The decreases in iodine value of all fats exceeded the five percent change necessary for lowered digestibility. When chicken was fried, cottonseed oil was the only fat which decreased in iodine value during use.

The lack of change in iodine values of these fats when chicken is fried is presumed to be due to dilution of the frying fat with fat from the chicken, which contains large amounts of linoleic acid. Lard provides an extreme example of the difference in change of iodine value caused by chicken and potatoes. When chicken was fried, the iodine value of lard increased to a value 12.8 to 22.2 per cent above the original value. However, when potatoes were fried the iodine value of lard decreased to a level 10.0 to 17.3 per cent below the original value. Dilution of frying fat by chicken fat may have been most notable in lard because this fat originally contained the least unsaturation, measured by iodine values. By the same reasoning, the dilution of cottonseed oil with chicken fat would have produced the least effect on iodine values, since cottonseed oil is more highly unsaturated than chicken fat. Whereas dilution of a less unsaturated fat (lard) by chicken fat raised its iodine value, dilution of a more unsaturated fat (cottonseed oil) by chicken fat lowered its iodine value. Other factors than linoleic acid may be involved here. Coons (14) has cautioned against the use of iodine value of a fat as an index of its linoleic acid content.

Table 6 shows the results of iodine values determined both on the frying fat and on fat extracted from floured chicken fried in lard and cottonseed oil. A comparison of these results with those given in Table 5 shows that a much smaller decrease in iodine value occurs when the frying fat is maintained at constant volume, just as was noted in the case of free fatty acids. In contrast to the results obtained above, where no turnover of fat occurred, iodine values of both cottonseed oil and lard decreased with use. The decreases in iodine value of lard were very small — 0.4 per cent in the iron pan and 1.2 per cent in the glass ceramic pan. These results support the explanation given for change in iodine values of the various fats in which chicken had been fried. In this case, addition of fresh cottonseed oil at the beginning of each frying period counteracts some of the effects of oxidation, resulting in only a slight change in iodine value. Dilution of lard with the more highly unsaturated chicken fat again results in an increased iodine value.

Although the kind of frying pan used

had a statistically significant effect on change in iodine number when either chicken or potatoes were fried, the effect was erratic. No trend toward greater change in any one kind of pan could be established. Interference with the determination of iodine values by other materials present in variable quantities in these foods may well have been responsible for these effects.

Unless the flavor is affected, change in the frying fat is not noticed by the consumer of fried products. However, changes in the fried food may reflect changes in the frying fat. Iodine values of fat extracted from chicken and potatoes fried in various fats are given in Table 7. This data, and that reported in Table 6 for fried chicken, shows that iodine values of fats extracted from cooked food are higher, in general, than iodine values of the fats in which the food was fried. Fat from chicken fried in cottonseed oil was the only food fat found to be lower in iodine value than the frying fat after ten hours use. Even in this case, however, the iodine value of the cooked chicken fat was greater than that of the fat from raw chicken, and was also greater than that of chicken fried in lard or hydrogenated animal-vegetable combination shortening.

When cottonseed oil was used as the frying medium, and a constant volume of fat was maintained through periodic addition of fresh oil, iodine values of cooked chicken fat were considerably higher than those of raw chicken, and in fact, approached that of the cottonseed oil itself. When lard was used in the same way, iodine values of the cooked chicken were generally about the same as that of raw chicken, a value considerably higher than that of lard itself. Iodine values of fat extracted from fried chicken, therefore, may or may not resemble those of the fat in which they are cooked. The use of a more highly unsaturated fat for frying results in a fried chicken end product which is more highly unsaturated. The kind of pan used has no effect on the iodine value of fried chicken fat.

Iodine values of fat extracted from fried potatoes bear a definite relationship to iodine values of the fats in which they were fried. Iodine values of both potato and pan fats increase in the following order: hydrogenated animal-vegetable combination shortening, lard, hydrogenated vegetable shortening and cottonseed oil. Most of the fat present in fried potatoes is that which was absorbed from the pan fat, as raw potatoes contain very little. Therefore, no interchange of fat occurs between that in the food and that in the frying pan as it does in the case of chicken. The absorption of fat is either selective toward absorption of more highly unsaturated fat or fatty acids from the pan, or other substances present cause misleadingly high iodine values, because iodine values of fat extracted from the potatoes are higher than those of the fats in which they are fried. Other protective agents against oxidation of fats, which may also be present in foods, may account for part of this effect.

Amount of Fat in Cooked Food

The amount of fat extracted from chicken and potatoes fried in various fats is given in Table 8. The amount of fat found in chicken fried in lard and cottonseed oil maintained at constant vol-

Table 7.—Iodine values (Hanus) of fat extracted from chicken and potatoes cooked in various fats.

Food:	Chicken		Potatoes	
Frying fat — Hours fat used:	5	10	5	10
Cottonseed oil	87.1	70.0	97.5	81.4
Lard	51.3	66.7	49.2	50.6
Hydrogenated vegetable shortening	77.9	74.4	64.6	58.7
Hydrogenated animal-vegetable combination shortening	66.4	66.4	49.0	47.9

Table 8.—Amount of fat extracted from chicken and potatoes cooked in various fats.

Frying fat	Hours used	Food: Chicken	Potatoes
		%	%
Cottonseed oil	0	6.58	0.16
	5	9.11	6.25
	10	14.56	9.39
Lard	0	6.58	0.16
	5	15.70	5.68
	10	14.22	6.60
Hydrogenated vegetable shortening	0	6.58	0.16
	5	13.68	9.36
	10	17.04	6.91
Hydrogenated animal-vegetable combination shortening	0	6.58	0.16
	5	13.42	7.60
	10	14.46	6.86

Table 9.—Amount of fat extracted from chickens fried successively in lard or cottonseed oil maintained at constant volume with fresh fat.

Hours	Fat:	Cottonseed oil		Lard	
fat used	Frying pan:	Iron	Glass ceramic	Iron	Class ceramic
		%	%	%	%
0.75		27.4	27.0	27.4	27.9
1.50		28.5	28.4	26.4	26.0
2.25		29.2	28.6	31.4	30.6
3.00		30.0	28.0	29.0	27.8
3.75		28.4	29.4	26.9	26.1
4.50		26.4	27.0	26.0	27.2
5.25		26.2	24.8	31.0	30.4
6.00		27.2	28.3	23.8	22.8
6.75		27.3	26.9	27.4	27.2
7.50		25.4	24.4	25.4	24.8

ume is given in Table 9. Fried chicken always contained more fat than fried potatoes, since chicken has a higher fat content to begin with. When values for the amount of fat extracted from cooked chicken were corrected for the amount of fat present in raw chicken, increases in amount of fat closely approached the values noted for potatoes.

Potatoes fried in hydrogenated animal-vegetable combination shortening contained more fat than those fried in any other fat after five hours of use. After all fats had been used for ten hours, potatoes fried in cottonseed oil had the highest fat content. An increase in the fat content of potatoes fried in lard and cottonseed oil occurred between five and ten hours use, whereas a decrease in fat content occurred during this time in potatoes fried in either of the hydrogenated shortenings. Fat content of chickens fried in all fats except lard increased between five and ten hours. Fat content of chicken fried in lard decreased during this time.

Each successive batch of chicken fried in cottonseed oil or lard, maintained at constant volume, contained slightly less fat than the preceding batch. Although this difference was statistically significant, inspection of the data, presented in Table 9, shows that the change was very slight. Neither kind of fat nor kind of pan used had any effect on the amount of fat present in the fried chicken.

Morgan and Cozens (38) have stated that a greater absorption of fat occurs when food is cooked in fat of lower free fatty acid content. Loss of water, as well as absorption of fat, affects the percentage of fat found in cooked food. Furthermore, interchange occurs between fat in the chickens and in the pans. There-

Table 10.—Amount of lipase hydrolysis occurring *in vitro* in fats used to fry successive batches of chicken or potatoes.

Frying fat	Hours fat used	Food fried:	Chicken		Potatoes	
		Pan:	Iron	Glass ceramic	Iron	Glass ceramic
			%	%	%	%
Cottonseed oil	0		8.90	8.90	9.64	9.64
	5		6.71	6.48	6.71	6.55
	10		6.58	4.79	4.80	4.54
Lard	0		7.96	7.96	9.66	9.66
	5		8.30	6.76	5.30	4.77
	10		8.14	7.73	4.72	3.66
Hydrogenated vegetable shortening	0		6.05	6.05	6.82	6.82
	5		6.50	7.38	4.58	4.76
	10		6.95	7.17	5.35	5.76
Hydrogenated animal-vegetable combination shortening	0		7.07	7.07	5.55	5.55
	5		7.79	7.96	5.26	5.88
	10		7.97	6.14	3.51	3.23

Table 11.—Amount of lipase hydrolysis occurring *in vitro* in fat extracted from successive batches of chicken fried in lard or cottonseed oil.

Frying pan	Hours fat used	Frying fat:	Cottonseed oil	Lard
Iron	0.75		22.3	18.8
	3.75		24.7	28.3
	6.75		25.0	21.2
Glass ceramic	0.75		23.3	13.0
	3.75		26.4	25.4
	6.75		22.4	27.1

fore, the total amount of fat extracted from fried chicken and potatoes, even when corrected for original amounts present, cannot be considered to be absorbed fat. A significant negative correlation (r = – .58) was found to exist between the free fatty acid content of the pan fat and the amount of fat extracted from the chicken. Approximately the same degree of correlation (r = – .54) was found to exist between the actual increase in free fatty acid content of the pan fat and the amount of fat in the fried chicken each time.

Hydrolysis of Fat *in vitro* by Pancreatic Lipase

Fat used to fry chicken and potatoes was hydrolyzed **in vitro** by reaction for 30 minutes with pancreatic lipase. Results obtained are given in Table 10. In general, the amount of hydrolysis by pancreatic lipase decreased with increased length of time of use of the fat. The total amount of hydrolysis occurring in all fats was higher after chicken was fried than after potatoes were fried. This result supports other data, such as free fatty acid content, which show a greater breakdown of fat when potatoes are fried.

When chicken was fried in iron pans, hydrolysis of all fats except cottonseed oil increased during the first five hours of heating. A further increase in hydrolysis occurred in the hydrogenated shortenings between five and ten hours of use but hydrolysis of both lard and cottonseed oil decreased during this time. When glass ceramic pans were used, hydrolysis of both hydrogenated shortenings increased during the first five hours of heating, while that of both lard and cottonseed oil was less than the original. Between five and ten hours all fats except lard decreased in amount of hydrolysis.

Fat extracted from the first, fifth and ninth batches of chicken fried in both lard and cottonseed oil was tested for amount of hydrolysis by lipase **in vitro.**

The results are given in Table 11. Chicken fried in lard in glass ceramic pans or fried in cottonseed oil in iron pans increased in hydrolysis each time a sample was tested. Cottonseed oil heated in glass ceramic pans and lard heated in iron pans increased in amount of hydrolysis between the first and the fifth fryings and decreased between the fifth and the ninth fryings. At the end of the ninth time of use of both fats in both pans, amount of hydrolysis was either about the same as, or higher than, after the first time the fat was used.

The activity of pancreatic lipase has been reported by Weinstein and Wynne (50) to be inhibited by the presence of carbonyl compounds. However, no correlation was found between the amount of carbonyl compounds present and the degree of hydrolysis occurring in these fats. A highly significant negative correlation ($r = -.32$) was found between the amount of hydrolysis by lipase and the free fatty content of the fats. This may have resulted from the fact, as Youngs (51) has reported, pancreatic lipase reacts primarily with the fatty acids in the 1 and 3 positions on the triglyceride molecules. These fatty acids are also the ones most susceptible, or most exposed to oxidation. Therefore, a decreased lipase activity could result from the fact that acids in these positions were already oxidized and changed. The fact that the greatest decrease in hydrolysis occurred in cottonseed oil, which was the most highly unsaturated fat tested, is evidence for the above statement.

SUMMARY AND CONCLUSIONS

Simulation of home frying procedures is difficult since many variable factors are involved. The frequency of use of the fat, the temperature at which it is stored between uses, the kind of container in which it is stored, the degree of scouring to which the frying pan is subjected, the kind of food fried and the preparation which the food undergoes before it is fried are some of the factors which may vary from one home kitchen to another.

Two simulated home kitchen frying procedures were chosen arbitrarily for use in this study. The effect of metal and non-metal (glass ceramic) frying pans on changes in composition of the fats were investigated in each case.

The first method involved the use of four different kinds of fats (lard, cottonseed oil, hydrogenated vegetable shortening and hydrogenated animal - vegetable combination shortening), to cook chicken or potatoes. Different batches of fat were used to fry each of these foods in both scoured and unscoured iron and glass ceramic frying pans. Each fat, in each kind of pan, was used to fry ten successive batches of either chicken or potatoes during a total heating time of ten hours. No fresh fat was added to replace either fat lost on removal of the fried food or that lost as a result of taking out samples of fat for later analysis. Therefore, each succeeding batch of chicken or potatoes was cooked in a smaller volume of the same fat. Samples of each fat, and of fried chicken and potatoes, were analyzed after five and ten hours use of the fats. After every second hour of use, all fats were stored overnight at 9° C in glass beakers.

The second method involved the use of only two kinds of fat (lard and cottonseed oil) in which ten successive batches of chicken were fried. The total heating time was 7.5 hours, divided into five frying periods. Chicken pieces were floured and salted before frying, and each frying pan was scoured after every second batch of chicken fried. At the beginning of each frying period, sufficient fresh fat from the original mixture was added to each pan to maintain a constant volume. Samples were analyzed from each batch of chicken fried and from fat at the end of each frying period. After each frying period, all fats were poured into glass beakers and stored overnight at 9° C.

The changes in composition of fats which occurred during repeated use were dependent upon the method used for frying, the kind of fat used, the kind of food fried and, to a limited extent, the kind of frying pan which was used for frying.

When fats were used to fry potatoes, a greater degradation of the fat occurred, through hydrolysis to form free fatty acids, than when the same fats were used to fry chicken.

Changes in iodine values of fats in which chicken was fried depended on the original iodine values of the fats. When chicken was fried in a fat which was more saturated than chicken fat itself, that is, one which had a lower iodine value than that of chicken fat, dilution by fat from the chicken raised the iodine value (increased the degree of unsaturation) of the fat in the frying pan. However, when chicken was fried in a more highly unsaturated fat, that is, one whose iodine value exceeded that of chicken fat, dilution by chicken fat had no ameliorating effect and the iodine value of the fat in the frying pan decreased (became less unsaturated).

Iodine values, or the degree of unsaturation, of fat extracted from fried chicken were also dependent upon iodine values of the frying fat. Although the iodine values of fat extracted from fried chicken were always at least as high as those from raw chicken, these values were much higher than those in raw chicken when an unsaturated fat like cottonseed oil was used as the frying fat. Iodine values of fat extracted from fried potatoes were also related to, but higher than, iodine values of the fat used for frying.

Well-scoured iron frying pans exerted a catalytic effect toward promoting larger amounts of carbonyl compounds in fats heated in them. Unscoured iron pans did not show this effect because their iron surface is coated with a thin layer of oxidized fat.

In general, the amount of hydrolysis taking place in frying fats when they are reacted with pancreatic lipase, **in vitro,** decreased slightly with increasing use of the fat. Hydrolysis of fats in which chicken was fried was always greater than that of fats in which potatoes were fried. Onset of foaming in these fats, which is associated with biologically significant changes, also occurred much more rapidly when potatoes were fried than when chicken was fried.

Occasional use of fats which have been used for too long a time at too high a temperature, probably will not cause any discomfort or harm to the person who eats the fried food. However some simple precautions can be taken to guard against abuse of fats used for frying. The following recommendations are made:

1. Discard a frying fat when it begins to foam severely when food is added to it.
2. Discard a frying fat when color changes become pronounced.
3. Use the largest amount of fat the frying container will hold and add fresh fat to maintain this volume each time the fat is used again for frying.

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APPENDIX. TABLES OF STATISTICAL ANALYSES

Table I.—F ratios obtained from analysis of variance of data from four fats used to fry chicken and potatoes.

Source	Degrees of freedom	F ratios Iodine values	 Total carbonyl compounds	 Free fatty acids	 Peroxide values
Kind of food fried (A)	1	952.399**	244.707**	20.361**	10.558**
Length of time fat used (B)	2	199.748**	805.718**	2935.431**	604.460**
Kind of frying pan (C)	3	3.200*	<1***	1.995***	20.701**
Kind of fat used (D)	3	3898.002**	60.263**	787.074**	19.066**
A x B Interaction	2	46.843**	54.454**	43.782**	1.516***
A x C Interaction	3	1.460***	2.404***	2.327***	6.727**
B x C Interaction	6	4.062**	3.737**	1.233***	5.590**
A x D Interaction	3	164.690**	7.900**	23.119**	20.484**
B x D Interaction	6	37.125**	33.626**	43.330**	27.177**
C x D Interaction	9	5.491**	2.058*	2.030*	3.454**
A x B x C Interaction	6	1.121***	1.541***	1.307***	6.555**
A x B x D Interaction	6	55.054**	10.647**	12.728**	19.069**
A x C x D Interaction	9	1.788***	1.024***	1.846***	2.706**
B x C x D Interaction	18	2.849**	1.226***	3.440**	2.955**
A x B x C x D Interaction	18	1.955*	<1***	1.480***	1.679***
Replicates	1	<1***	<1***	<1***	<1***
Error	95				
Total	191				

**Significant at the 1% level.
*Significant at the 5% level.
***Not significant.

Table II.—Mean peroxide values[1] for each fat used to fry chicken in each pan at all sampling times.

Kind of fat Frying pan:	Scoured iron	Unscoured iron	Scoured Glass ceramic	Unscoured Glass ceramic
Cottonseed oil	3.44a	3.98a	3.64a	4.41a
Hydrogenated vegetable shortening	3.31a	3.02a	3.81a	3.75a
Hydrogenated animal-vegetable combination shortening	4.86a	6.28a,b	6.84b	7.00b
Lard	3.61a	4.55a	3.71a	4.28a

[1]Values not followed by the same letter differ significantly from one another at the 1% level.

Table III.—Mean peroxide values[1] for each fat used to fry potatoes in each pan at all sampling times.

Kind of fat Frying pan:	Scoured iron	Unscoured iron	Scoured Glass ceramic	Unscoured Glass ceramic
Cottonseed oil	4.53a	3.11a	4.58a	3.04a
Hydrogenated vegetable shortening	2.62a	2.77a	5.08b	5.20b
Hydrogenated animal-vegetable combination shortening	2.63a	3.14a	4.85b	4.94b
Lard	2.43a	3.94b	5.50b	4.77b

[1]Values not followed by the same letter differ significantly from one another at the 1% level.

Table IV.—Mean peroxide values[1] for each fat used to fry chicken at each sampling time in all pans.

Kind of fat Time:	0	5	10
Cottonseed oil	B 1.56a	A 4.81b	B 5.24b
Hydrogenated vegetable shortening	A 0.36a	A 4.92b	B 5.13b
Hydrogenated animal-vegetable combination shortening	A 0.45a	C 9.60b	C 8.69b
Lard	A,B 1.20a	B 7.13b	A 3.78c

[1]Values in columns not preceded by the same letter differ significantly from one another at the 5% level. Values in rows not followed by the same letter differ significantly from one another at the 5% level.

Table V.—Mean peroxide values[1] for each fat used to fry potatoes at each sampling time in all pans.

Kind of fat	Time:	0	5	10
Cottonseed oil		A 0.97a	A 3.02b	C 7.46c
Hydrogenated vegetable shortening		A 0.26a	B 6.68b	A,B 4.81c
Hydrogenated animal-vegetable combination shortening		A 0.53a	B 7.26b	A 3.88c
Lard		A 0.41a	B 6.29b	B 5.77b

[1] Values in columns not preceded by the same letter differ significantly from one another at the 5% level. Values in rows not followed by the same letter differ significantly from one another at the 5% level.

Table VI.—Mean peroxide values[1] for all fats used to fry chicken in each pan at each sampling time.

Frying pan	Time:	0	5	10
Scoured iron		0.89	A 5.24	A 5.28
Unscoured iron		0.89	A 6.38	A 6.10
Scoured glass ceramic		0.89	B 6.80	A 5.81
Unscoured glass ceramic		0.89	B 8.03	A 5.66

[1] Values not preceded by the same letter differ significantly (1%level) from other values in the same column.

Table VII—Mean peroxide values[1] for each fat used to fry chicken in each pan after 5 hours use.

Frying pan	Fat:	Cottonseed oil	Hydrogenated vegetable shortening	Hydrogenated animal-vegetable shortening	Lard
Scoured iron		4.17	A 4.64	A 6.35	A 4.76
Unscoured iron		3.51	A,B 5.65	B 8.50	A,B 6.02
Scoured glass ceramic		4.37	A,B 5.76	B 9.37	C 8.27
Unscoured glass ceramic		3.62	A,B 7.16	B 9.49	B,C 7.80

[1] Values not preceded by the same letter differ significantly (1%level) from other values in the same column.

Table VIII.—Mean peroxide values[1] for each fat used to fry chicken in each pan after 10 hours use.

Frying pan	Fat:	Cottonseed oil	Hydrogenated vegetable shortening	Hydrogenated animal-vegetable shortening	Lard
Scoured iron		6.54	A 3.94	A 4.39	A 3.50
Unscoured iron		5.86	A 2.72	A 5.14	B 5.91
Scoured glass ceramic		6.70	B 7.26	B 7.68	A,B 4.74
Unscoured glass ceramic		6.29	B 6.00	B 7.93	A,B 4.97

[1] Values not preceded by the same letter differ significantly (1% level) from other values in the same column.

Table IX.—F ratios obtained from separate analyses of variance of free fatty acids[1] of all fats used to fry chicken or potatoes.

Source	Degrees of freedom	F ratios	
		Chicken[2]	Potatoes[3]
Length of time fat was used (B)	1	391.16**	1159.40**
Kind of frying pan (C)	3	1.84***	3.68*
Kind of fat used (D)	3	109.86**	379.12**
C x D interaction	9	1.35***	2.24*
B x C Interaction	3	<1***	0.00***
B x D Interaction	3	6.84**	29.32**
B x C x D Interaction	9	2.00***	3.80**
Error	32		
Total	63		

[1] Calculated as oleic acid.
[2] LSD$_{05}$ is .06; LSD$_{01}$ is .08.
[3] LSD$_{05}$ is .10; LSD$_{01}$ is .14.
***Not Significant.
*Significant at the 5% level.
**Significant at the 1% level.

Table X.—F ratios obtained from separate analyses of variance of total carbonyl compounds[1] of all fats used to fry chicken or potatoes.

Source	Degrees of freedom	F ratios	
		Chicken[2]	Potatoes[3]
Legth of time fat was used (B)	1	29.78**	55.44**
Kind of frying pan (C)	3	<1***	7.69**
Kind of fat used (D)	3	39.46**	39.15**
C x D Interaction	9	1.59***	1.34***
B x C Interaction	3	3.30*	1.66***
B x D Interaction	3	6.79**	19.625**
B x C x D Interaction	9	<1***	1.81*
Error	32		
Total	63		

[1] Calculated as n - heptaldehyde.
[2] LSD$_{05}$ is .11; LSD $_{01}$ is .15.
[3] LSD$_{05}$ is .06; LSD$_{01}$ is .08.
***Not significant.
**Significant at the 1% level.
*Significant at the 5% level.

Table XI.—F ratios obtained from separate analyses of variance of iodine values (Hanus) of all fats used to fry chicken or potatoes.

Source	Degrees of freedom	F ratios	
		Chicken[1]	Potatoes[2]
Length of time fat was used (B)	1	51.91**	66.57**
Kind of frying pan (C)	3	1.32***	3.46*
Kind of fat used (D)	3	534.83**	837.72**
C x D Interaction	9	4.32**	2.29*
B x C Interaction	3	3.11*	1.24***
B x D Interaction	3	14.02**	7.19**
B x C x D Interaction	9	2.21*	1.91***
Error	32		
Total	63		

[1] LSD$_{05}$ is 4.5; LSD $_{01}$ is 6.0.
[2] LSD$_{05}$ is 1.9; LSD$_{01}$ is 2.7.
***Not significant.
*Significant at the 5% level.
**Significant at the 1% level.

Table XII.—F ratios obtained from analysis of variance of data from lipase hydrolysis of all fats used to fry chicken and potatoes.

Source	Degrees of freedom	F ratios	
		Chicken[1]	Potatoes[2]
Times fat used (B)	1	6.12*	12.28**
Kind of frying pan (C)	3	4.34*	<1***
Kind of fat used (D)	3	18.58**	3.54*
C x D Interaction	9	3.63**	1.31***
B x C Interaction	3	2.30***	<1***
B x D Interaction	3	4.06*	4.52**
B x C x D Interaction	9	5.81**	<1***
Replicates	1		
Error	31		
Total	63		

[1] LSD_{05} is 1.21 ;LSD_{01} is 1.63.
[2] LSD_{05} is 1.21; LSD_{01} is 1.62.
*Significant at the 5% level.
**Significant at the 1% level.
***Not significant.

Table XIII.—F ratios obtained from analysis of variance of data from fat extracted from chicken fried in lard and cottonseed oil.

Source	Degrees of freedom	F ratios		
		Amount of fat	Iodine values	Free fatty acids
Kind of fat used (D)	1	<1***	229.22**	3.79***
Kind of frying pan (C)	1	<1***	<1***	<1***
D x C Interaction	1	<1***	<1***	1.32***
Replicates	1	<1***	2.55***	2.60***
Error a	3			
Times fat used (B)	9	4.05**	3.46**	1.83***
D x B Interaction	9	3.42**	1.11***	2.33*
C x B Interaction	9	<1***	<1***	<1***
D x C x B Interaction	9	<1***	<1***	1.03***
Error b	36			
Duplicates	80			
Total	159			

***Not significant.
**Significant at the 1% level.
*Significant at the 5% level.

Table XIV.—F ratios obtained from analysis of variance of data when lard and cottonseed oil were used to fry chicken.

Source	Degrees of freedom	F ratios	
		Iodine values	Free fatty acids
Times fat used (B)	4	5.76**	71.00**
Kind of frying pan (C)	1	<1***	6.50*
Kind of fat used (D)	1	25443.75**	1792.25**
C x D Interaction	1	1.12***	1.75***
B x C Interaction	4	<1***	1.75***
B x D Interaction	4	17.84**	1.88***
B x C x D Interaction	4	1.75***	1.50***
Replicates	1	2.67***	0.12***
Error	19		
Duplicates	40		

***Not significant.
*Significant at the 5% level.
**Significant at the 1% level.

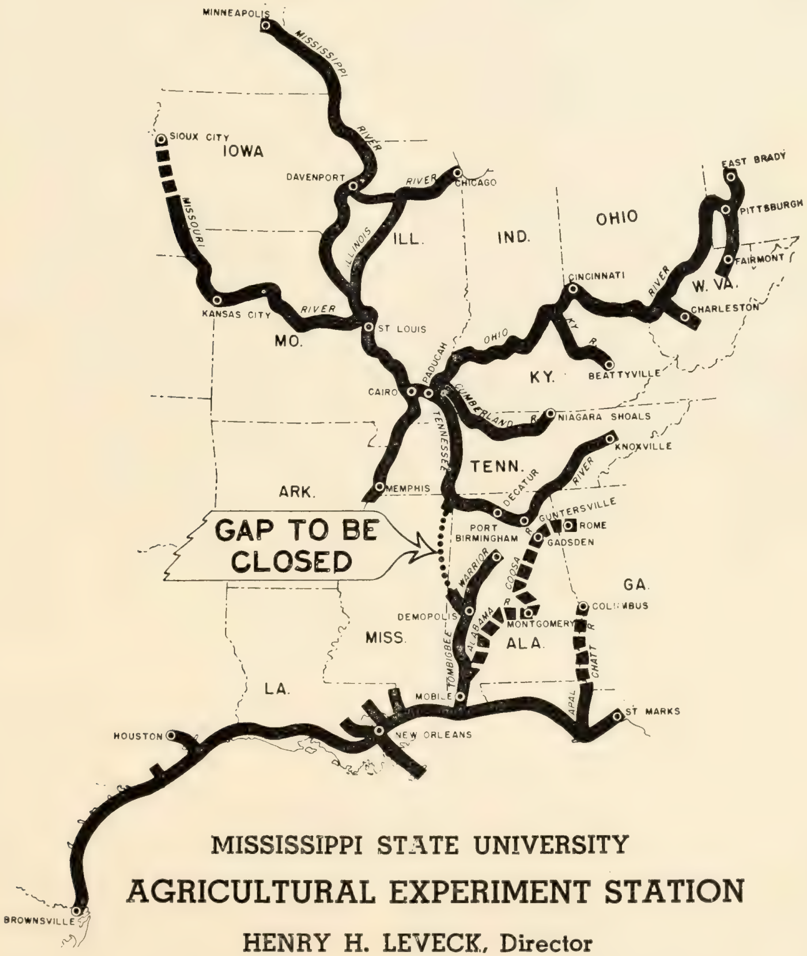
Table XV.—F ratios obtained from analysis of variance of data from lipase hydrolysis of fat extracted from chicken fried in lard and cottonseed oil.

Source	Degrees of freedom	F ratios
No. of times fat used (B)	2	22.10**
Kind of fat used (D)	1	4.07***
Kind of frying pan (C)	1	<1***
C x D Interaction	1	<1***
B x D Interaction	2	9.30**
B x C Interaction	2	1.92***
B x C x D Interaction	2	7.88**
Error	12	
Total	23	

***Not significant.
**Significant at the 1% level.

BULLETIN 663 MAY 1963

Potential Effects Of The Proposed Tennessee-Tombigbee Waterway On Mississippi Grain Marketing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ROME
GADSDEN
PORT BIRMINGHAM
GAP TO BE CLOSED
WARRIOR
COOSA R
GA.
COLUMBUS
DEMOPOLIS
ALABAMA R
MONTGOMERY
MISS.
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PREFACE

The rapid expansion of livetock production in the South within recent years has made it imperative that researchers focus considerable attention on the area's livestock and feed economy. Much of the research conducted in this field has been concerned with feed-grain production and utilization and ways of improving marketing in the grain-deficit Southeast. The study reported in this bulletin examines the potential effects of the proposed Tennessee-Tombigbee Waterway on grain marketing in Mississippi.

This study is a part of Mississippi's contribution to the Southern Regional Grain Marketing Project SM-11, Revised, "Transportation of Grain and Grain Products in the South." Other agencies cooperating in this research are the Agricultural Experiment Stations in Alabama, Arkansas, Florida, Georgia, Louisiana, North Carolina, South Carolina, and Tennessee; the Market Economic Branch and the Farmer Cooperative Service of the U. S. Department of Agriculture; and the Navigation Economics Branch of the Tennessee Valley Authority.

This publication is one of a series that will be published under this project. On the regional level one report will contain a description of grain and grain product movements associated with the South. A second regional publication will report the results of a spatial equilibrium price analysis. A more detailed description of Mississippi grain and grain product movements than is contained in this or the regional report will be contained in a second Mississippi report.

The author expresses his thanks to all who supplied data for this study. Appreciation is also expressed to V. G. Hurt, D. W. Parvin, T. D. Phillips, L. D. Welch, and C. M. Wells, Jr. for their critical reading of the manuscript.

SUMMARY AND CONCLUSIONS

Determining the most economical sources of grain for grain-deficit Mississippi and finding economical means of transporting soybeans for export are important problems of Mississippi grain handlers. Much of the grain now used in the state comes by truck, rail, and barge from the Midwest. The proposed Tennessee-Tombigbee Waterway would afford to the eastern section of Mississippi waterway transportation, usually the least costly method of moving grain. This study was undertaken to determine the Mississippi area expected to be most directly affected by the waterway and to estimate the effects of this waterway on the production and utilization of grain in that area. To accomplish this, it was necessary to describe existing patterns of grain movements to and from the state and to estimate quantities of grain being moved.

Mississippi grain handlers procured an estimated 15 million bushels of grain from out-of-state sources in 1959 and over 17.5 million bushels in 1960. Most of this was corn from the Midwest, with Illinois supplying the largest quantity. Quantities of shipped-in grain moving by truck and by barge down the Mississippi River were about equal in 1960. Rail shipments accounted for only a small proportion of receipts from out-of-state. About three-fourths of the 11 million bushels of grain shipped out of the state in 1960 was soybeans. These were moved primarily by barge and rail.

As delineated by comparative transfer costs, the area of Mississippi in which the proposed waterway would have the greatest impact on grain procurement costs would be a 27-county area along the state's eastern border. This area is an important livestock and poultry producing one and is deficit in grain production. More than 2 million bushels of grain were shipped into the area from other states in 1960.

Feed-grain production in the area has not changed significantly since 1953. Grain requirements, meanwhile, have increased at an annual rate of 3.2 percent. Should these trends continue, the area will depend more and more heavily upon other areas for its feed-grain. Comparative transfer costs indicate the possibility of substantial savings through bringing in Midwest feed-grain via the proposed waterway. Estimated savings at selected receiving points on the waterway could be such as to reduce broiler production costs by a minimum of .66 cents per bird and beef cattle production costs by a maximum of $6.24 per 400 pounds of gain in a 750-pound steer. As the grain moves inland from these selected receiving points, additional handling and transportation charges would reduce these savings.

Any savings in transfer costs for feed-grain being shipped into the area should put the feed-grain user in a more favorable position, and the feed-grain producer in a less favorable position. However, for the soybean producer, the waterway would afford a cheaper means of transporting soybeans from the area to ports on the Gulf for export. From northeast Mississippi possible savings of 5 to 6 cents per bushel in transportation costs could be realized. This would tend to favor increases in soybean production in the area.

The extent of the effects of the waterway will depend primarily upon the actual rate structure which develops for the waterway. On the other hand, it is logical to expect that the opening of the waterway would accelerate area developments in fields other than agriculture. Whether such developments would be sufficient to materially affect the pattern of farming is a question beyond the scope of this study.

POTENTIAL EFFECTS OF THE PROPOSED TENNESSE-TOMBIGBEE WATERWAY ON MISSISSIPPI GRAIN MARKETING

By ROBERT G. BROOKS

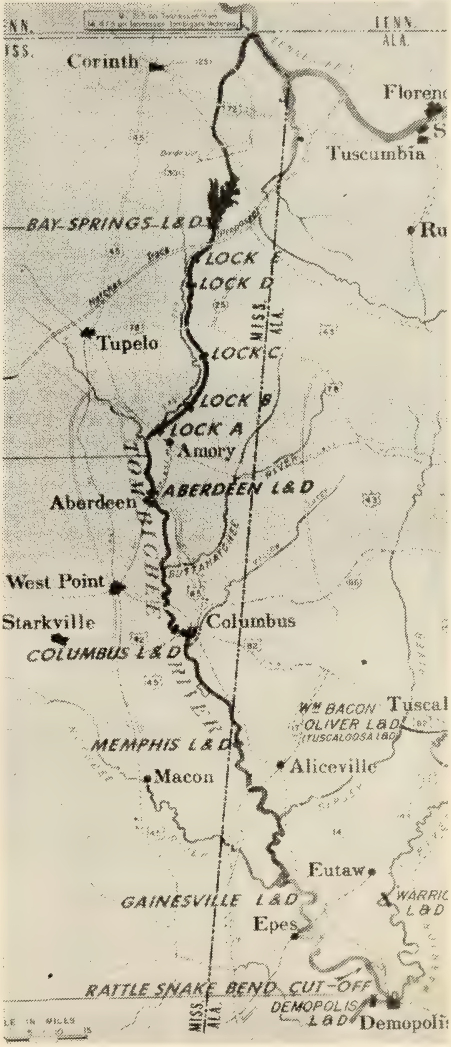
INTRODUCTION

The Problem

One of the primary problems confronting grain-users in Mississippi is the procurement of out-of-state grain to supply needs that cannot be met from production on farms in the state. Most of the deficit is being met by grain moving from North Central States by truck, rail, and barge or some combination of these. Movement into the state from barge terminals on the Mississippi River is substantial. The proposed Tennessee-Tombigbee Waterway would make barged grain more readily accessible to users in Eastern Mississippi.

The proposed waterway provides a connecting link between the Tennessee River and the Gulf of Mexico through the port of Mobile (Figure 1). The existing waterway project authorizes the connection to be made ". . .by way of the East Fork of the Tombigbee River, Mackeys and Yellow Creeks, to provide a channel from the junction of the Tombigbee and Warrior at Demopolis, Alabama, to the Pickwick pool on the Tennessee River . . . "[1]

The Doane Agricultural Service, Inc., estimates that seventy percent of the land area in the primary tributary area of the proposed waterway is within 25 miles of navigable waterways, and that sufficient port facilities will develop to make 55 percent of the land area in this main tributary area within a radius of 25 miles of these ports.[2] A substantial proportion of this area is in Mississippi since the proposed waterway lies either in the state or just east of the Mississippi-Alabama State line.


TENN.
MISS.
ALA.
Corinth
Florenc
Tuscumbia
BAY SPRINGS L&D
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LOCK E
LOCK D
Tupelo
LOCK C
LOCK B
LOCK A
Amory
Aberdeen
ABERDEEN L&D
West Point
Starkville
Columbus
COLUMBUS L&D
WM BACON
OLIVER L&D
TUSCALOOSA L&D
Tuscal
MEMPHIS L&D
Macon
Aliceville
Eutaw
GAINESVILLE L&D
WARRIOR L&D
Epes
RATTLE SNAKE BEND CUT-OFF
DEMOPOLIS L&D
Demopoli

Figure 1.—The Tennessee-Tombigbee Waterway.

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[1] U. S. Army Corps of Engineers, Mobile District, **Restudy of Tennessee-Tombigbee Waterway, Alabama and Mississippi** (Mobile, Alabama, 1960), p. 15.

[2] Tennessee-Tombigbee Waterway Development Authority, **Comments on the Tennessee-Tombigbee Restudy Report** (Columbus, Mississippi, 1961) ,section 2, p. ii.

In view of the fact that substantial economies are frequently associated with the movement of grain by barge the potential effects of this waterway on grain movements in Mississippi merit investigation.

Purpose and Procedure

This study was undertaken to estimate the potential effects of the proposed Tennessee-Tombigbee Waterway on Mississippi Grain marketing. The more specific objectives were to:

(1) Describe movements of grain[3] to and from Mississippi in 1959 and 1960.

(2) Determine the area of Mississippi that will be affected by the waterway.

(3) Examine the potential effect of the waterway upon grain and livestock production in that area.

Analysis of 1959 and 1960 grain movements to and from Mississippi is based on data from a sample of 95 feed mill, grain elevator, and oil mill operators in the state. These operators supplied, for the various grains handled, data on volume, modes of transportation, and origin (destination, in the case of out-shipments).

Frequently, single shipments of grain utilize two or more modes of transportation. For purposes of the present analysis however, the mode by which a shipment entered or left the state was assumed to have been used from origin to destination. Exception to this assumption was made in the case of grain distributed from Memphis to Mississippi by truck. Memphis was indicated as an important source of certain grains; however, it is believed that most of these grains moved from the North Central Region into Memphis by barge and were distributed from there into Mississippi by truck. But because of the location of Memphis relative to Mississippi and because certain other barge movements to Mississippi could not be released without disclosing the operations of individual firms, Memphis was considered as a barge point within Mississippi.

A spatial analysis involving price of number 2 yellow corn at shipping points and transfer charges for corn to destinations was made to determine the area in Mississippi that would be affected by the waterway. This area was defined in terms of relative costs of corn received via the waterway and competing routes. Six river points were selected in the North Central Region as likely origins for grain moving from that area to Mississippi. Also, likely receiving points on the Mississippi River, the proposed Tennessee-Tombigbee Waterway, and the Warrior - Tombigbee Waterway were selected for grain moving into the state. Transfer charges before the waterway were compared to those after the waterway to estimate the potential savings in transportation. The potential effects upon grain and livestock production were examined with respect to these potential savings.

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[3] Includes soybeans.

GRAIN MOVEMENT PATTERNS IN MISSISSIPPI, 1959-60

Some knowledge of existing grain movement patterns is essential to a valid estimate of the potential effects of the proposed Tennessee - Tombigbee Waterway on future patterns. Estimates of the kinds and quantities of grains moving to and from Mississippi in 1959 and 1960 and information on sources, destinations, and modes of transportation of these grains are therefore presented in this section of this study.

In-shipments[4]

Mississippi grain handlers purchased

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[4] Grain shipped into Mississippi from other states.

approximately 15 million bushels of grain from out-of-state sources in 1959 and over 17.5 million bushels in 1960 (Table 1). Corn comprised about 80 percent of the total volume of grain in-shipments. Most of this shipped-in corn came from the Midwest, with Illinois supplying more than any of the states which were indicated as a state of origin. However, the specific state of origin for over 2-million bushels coming from the Midwest could not be determined.

Both oat and soybean in-shipments exceeded a million bushels in 1959 and 1960. The Midwest supplied about three-fourths of the oat in-shipments. Wheat and grain sorghum receipts were less than a million bushels for both years, however 1960 receipts approximately doubled over 1959.

Out-shipments[5]

Grain shipped out of Mississippi amounted to approximately 8.6 million bushels in 1959 and 11 million bushels in 1960 (Table 2). Soybeans accounted for about three-fourths of these shipments in both 1959 and 1960. Out-shipments of both corn and oats were below in-shipments, but out-shipment volumes of these grains, as well as that of wheat, approached or exceeded half a million bushels. While quantities of other grains shipped from the state were relatively small in both years, they increased sharply in 1960. Considering all grains, in-shipments exceeded out-shipments by approximately 6.5 million bushels in both 1959 and 1960.

Mississippi handlers shipped grain primately to the Southeastern states and for export (Appendix A, Table 4). Most of the soybean out-shipments went to the Gulf for export, with small quantities going to Alabama and Tennessee. It is highly possible that some of the shipments to Alabama and Tennessee went for export, also. Grain out-shipments other than soybeans went primarily to Alabama, Louisiana, and Tennessee.

Modes of Transportation

In 1959 grain in-shipments by truck exceeded those by both rail and barge, even though Midwest grain barged to Memphis for redistribution to Mississippi was considered as entering the state by barge (Table 3). In 1960 greater propor-

Table 1.—In-shipments of grain to Mississippi handlers, by state of origin, 1959 and 1960.

Type of grain and year	State of origin Ala.	Tenn.	Ill.	Ind.	Minn.	Mo.	Midwest[1]	Neb.	Texas	Other Western States	Other[2]	Total
1959							(1000 bushels)					
Corn	----	662	4,784	439	1,641	2,473	2,026	----	----	----	----	12,025
Oats	19	199	----	----	----	25	746	27	----	----	8	1,024
Wheat	----	----	----	----	----	----	----	----	----	----	100	100
Grain sorghum	----	----	----	----	----		32	----	14	235	208	489
Soybeans	----	----	----	----	----	----	----	----	----	----	1,319	1,319
All grains	19	861	4,784	439	1,641	2,498	2,804	27	14	235	1,635	14,957
1960												
Corn	----	648	7,003	549	1,368	2,416	2,152	----	----	----	----	14,136
Oats	22	164	----	----	----	29	783	33	----	----	7	1,038
Wheat	----	----	----	----	----	----	42	----	----	----	145	187
Grain sorghum	----	----	----	----	----	----	620	----	----	235	53	908
Soybeans	----	----	----	----	----	----	261	----	----	----	1,033	1,294
All grains	22	812	7,003	549	1,368	2,445	3,858	33	----	235	1,238	17,563

Source: Appendix A, Tables 1, 2, and 3.

[1] Includes all Midwest grain for which specific origin could not be disclosed.

[2] Includes movements for which specific origins could not be disclosed.

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[5] Grain shipped out of Mississippi.

Table 2.—Net in-shipments and out-shipments of grain by Mississippi grain handlers, 1959 and 1960.

Type of grain and year	In-shipments	Out-shipments	Net difference[1]
		(1000 bushels)	
1959			
Corn	12,025	792	—11,233
Oats	1,024	757	—267
Wheat	100	488	388
Barley	----	54	54
Grain sorghum	489	3	—486
Soybeans	1,319	6,505	5,186
All grains	14,957	8,599	—6,358
1960			
Corn	14,136	936	—13,200
Oats	1,038	955	—83
Wheat	187	697	510
Barley	----	71	71
Grain sorghum	908	204	—704
Soybeans	1,294	8,117	6,823
All grains	17,563	10,980	—6,583

Source: Table 1 and Appendix A, Table 4.

[1] Negative values indicate that in-shipments exceeded out-shipments.

Table 3.—Grain in-shipments: Percentage of volume received by truck, rail, and barge, by type of grain, Mississippi, 1959 and 1960.

Type of grain and year	Mode			Total
	Truck	Rail	Barge	
		(percent)		
1959				
Corn	52	7	41	100
Oats	8	22	70	100
Wheat	100	----	--	100
Grain sorghum	51	42	7	100
Soybeans	100	----	----	100
All grains	53	9	38	100
1960				
Corn	48	6	46	100
Oats	8	19	73	100
Wheat	78	----	22	100
Grain sorghum	31	1	68	100
Soybeans	79	1	20	100
All grains	47	6	47	100

Source: Table 1 and Appendix A, Tables 1, 2, and 3.

tions of all grain in-shipments were received by barge, making barge and truck receipts about equal. Less than 10 percent of the grain in-shipments were received by rail in either year. Rail receipts consisted mainly of corn from Tennessee (Appendix A, Table 2).

Out-shipments of grain from the state moved for the most part by barge and rail (Table 4). All barge and rail movements for export were combined as the barge movements could not be published separately. These movements consisted of wheat and soybeans. Rail movements other than for export were relatively small. Out-shipments by truck made up approximately one-fifth of total out-shipments for both years.

Table 4.—Grain out-shipments: Percentage of volume moving by truck, rail, and barge, by type of grain, Mississippi, 1959 and 1960.

Type of grain and year	Mode			Total
	Truck	Rail	Barge	
		(percent)		
1959				
Corn	91	9	----	100
Oats	77	23	----	100
Wheat	2	13	85	100
Barley	100	----	----	100
Grain sorghum	----	100	----	100
Soybeans	4	15	81	100
All grains	19	15	66	100
1960				
Corn	93	7	----	100
Oats	82	18	----	100
Wheat	3	13	84	100
Barley	100	----	----	100
Grain sorghum	100	----	----	100
Soybeans	1	12	87	100
All grains	19	12	69	100

Source: Appendix A, Table 5.

MISSISSIPPI AREA AFFECTED BY THE WATERWAY[6]

It is obvious from the material presented in the previous section that barge plays an important role in grain movements to Mississippi. With the opening of the Tennessee - Tombigbee Waterway, grain would conceivably move by barge from the North Central Region via the Tennessee River to receiving points along the Tennessee - Tombigbee and Warrior-Tombigbee Waterways for inland distribution by truck or rail. The procedure used for determining the area of Mississippi likely to be affected by the waterway was one of determining the location of the area in the state to which corn could be brought in more cheaply by the waterway than by other means. This procedure necessitated the adjustment of prices of corn in the supply area by the total cost of transfer to receiving points by different modes of transportation.

Supply Points, Prices, and Receiving Points

Six shipping points along the upper Mississippi and the Ohio River were selected as likely origins for grain being shipped into Mississippi. These points were Cincinnati, Louisville and Evansville on the Ohio, and Minneapolis, St. Louis, and Cairo on the Mississippi. Number 2 yellow corn prices at these selected points were based on a five year average for the period 1956-60 (Table 5).

Eight receiving points were selected for grain moving into Mississippi, four on the Mississippi River and four on the Tennessee - Tombigbee and the Warrior-Tombigbee Waterways. The four along the Mississippi were Memphis, Greenville, Vicksburg, and Natchez. On the opposite side of the state the selected points included Fulton and Columbus, Mississippi and Demopolis and Mobile, Alabama. The four points on the Mississippi were selected because grain presently moves into or out of Mississippi through these points.

Of the points selected on the Tennes-

---

[6] Corn prices and transportation rates were used in making this analysis.

Table 5.—Five year average of number 2 yellow corn prices at selected points, 1956-60.

	(Cents per bushel)
Cincinnati	122
Louisville	120
Evansville	120
Cairo	123
St. Louis	124
Minneapolis	111

Source: Averages were computed from the data presented in Appendix C, Table 3. Price series for some of the selected shipping points were not available. The data and procedure for deriving such series are presented in Appendix C, Tables 2 and 3.

see-Tombigbee and Warrior-Tombigbee, Mobile is the only one with grain handling facilities capable of handling barge transportation. The other three points, Fulton, Columbus, and Demopolis were selected as likely locations in which grain-handling facilities might develop. Fulton is near the second largest broiler and soybean producing area in the state and one of the largest dairy producing areas. Columbus is near the center of the Prairie section of Mississippi, an important beef cattle and dairy producing area. Demopolis is approximately 100 miles to the east of the largest broiler producing area in Mississippi and is also near a large cattle producing area of Alabama. All of these points are located on major hard-surface highways and on rail lines which would facilitate the moving of grain by barge, rail and truck combination.

Transportation Costs

Barge Rates used are presented in Tables 6 and 7. The procedure for computing barge rates for the Tennessee-Tombigbee Waterway is presented in Appendix B.

Thirty-nine trucking charges associated with movements within and to Mississippi were obtained from feed mills and grain elevators within the state (Appendix C, Table 1). Regression analysis of these thirty-nine observations (presented in Appendix C, Table 1) gave the transportation function, $Y = 5.31662 + .024718X$, where Y represents cents per bushel and X distance in miles.[7] Trucking rates derived from this function are presented in Table 8.

Rail rates considered were obtained from Tennessee Valley Authority and are flat rail rates in bulk carload lots (Table 9).

Handling and Merchandising Charges

Total transfer costs were obtained by adding necessary handling and merchandising costs to transportation costs. Handling charges used were those published by Alabama State Docks Department, Mobile, Alabama (Table 10). These charges are comparable to the 2.63 cents per bushel average of the estimated grain handling charges on inland waterways in 1957.[8] Merchandising charges or shippers returns were estimated at 5 cents per bushel.

In computing total transfer charges from point of origin to point of destination it was assumed that handling and merchandising charges on the shipping end were reflected in the selling price. To this selling price was added the transportation costs, handling charges, and merchandising charges required to place grain in the elevator at its final destination.

Procurement Costs of Corn at Barge Points

Barge was found to be the most economical means of moving corn from the North Central Region to Mississippi (Appendix C, Tables 4, 5, 6, 7, 8). Therefore, barge transportation rates and associated handling charges were used in determining the cheapest sources for each of the selected receiving points (Table 11).

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[7] An r-value of .95 was obtained indicating that 90 percent of the variability in trucking charges was accounted for by distance. The b-value of .024718 was significant at the one percent level

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[8] Halderman, Robert C., **Potential Effects of St. Lawrence Seaway on Costs of Transporting Grain,** (Marketing Research Report No. 319). (Washington, D. C., April, 1959), p. 84.

Table 6.—Barge rates for corn between selected points via Mississippi River, January, 1962.

From	To Memphis	Greenville	Vicksburg	Natchez	Mobile
			(cents per bushel)		
Cincinnati	06.38	08.06[1]	08.88[1]	09.69[3]	10.92
Louisville	05.94	07.62[2]	08.44[2]	08.74[3]	09.97
Evansville	04.42	06.10	06.92	07.50	08.96
Cairo	04.23	04.23	05.46	06.05	08.60
St. Louis	04.42	06.10	06.92	07.50	08.96
Minneapolis	10.42	12.35	13.16	13.78	15.26

Source: Arrow Transportation Company, **Guide to Published Barge Rates on Bulk Grain** (Schedule No. 3). (Sheffield, Alabama, January, 1962).

[1] Rate from Cincinnati to each of these points was computed by adding 1.96 cents to the Evansville rate to each of these points. The 1.96 cents represents the difference between the Cincinnati and the Evansville rates to Memphis.

[2] Rate from Louisville to each of these points was computed by adding 1.52 cents to the Evansville rate to each of these points. The 1.52 cents represents the difference between the Louisville and the Evansville rates to Memphis.

[3] Assumed the same as the published rate to Baton Rouge and New Orleans.

Table 7.—Estimated baige rates for corn between selectd points via Tennessee-Tombigbee Waterway, 1962.

From	To Fulton	Columbus	Demopolis	Mobile
		(cents per bushel)		
Cincinnati	08.67	09.23	10.34	10.92
Louisville	07.19	07.75	08.85	09.97
Evansville	05.89	06.45	07.56	08.96
Cairo	05.08	05.64	06.74	08.60
St. Louis	06.58	07.14	08.25	08.96
Minneapolis	12.39	12.95	14.06	15.26

Source: Rates to Fulton, Columbus, and Demopolis were computed by the procedure set forth in Appendix B. Rate to Mobile assumed to be the same as the published rate via the Mississippi River (Table 6).

Table 8.—Trucking rates for corn between selected points.[1]

To	From Cincinnati	Louisville	Evansville	Cairo	St. Louis	Minneapolis
			(cents per bushel)			
Fulton	18.89	16.19	14.31	11.05	14.73	28.75
Columbus	20.10	17.33	15.45	12.16	15.85	29.86
Demopolis	20.69	18.27	17.68	15.75	19.43	33.45
Mobile	23.86	21.43	20.84	17.70	21.38	35.40
Memphis	18.37	15.40	12.04	9.47	13.08	26.85
Greenville	21.98	19.01	15.65	13.08	16.69	29.79
Vicksburg	23.83	20.86	17.50	14.93	18.54	32.04
Natchez	26.40	24.70	19.21	16.64	20.25	33.74

[1] Rates computed from the function $Y = 5.31662 + .024718X$ and the distances persented in Appendix C, Table 9.

Minneapolis was the cheapest source for all receiving points. The next cheapest source for all the selected receiving points was Evansville. Evansville was chosen in preference to Minneapolis as its prices are more nearly representative of all the points than Minneapolis. This is not implying that all of the corn barges into

Table 9.—Flat rail rates for corn in bulk carloads between selected points.

To	From Cincinnati	Louisville	Evansville	Cairo	St. Louis	Minneapolis
			(cents per bushel)			
Fulton	27.16	23.80	21.00	14.84	21.56	48.16[1]
Columbus	27.16	24.36	21.56	15.40	22.12	48.72[1]
Demopolis	28.28	25.48	24.36	19.88	25.48	53.20[1]
Mobile	31.64	29.40	28.28	24.92	29.40	58.24[1]
Memphis	24.36	20.44	16.52	11.48	16.52	43.40
Greenville	28.84	26.04	23.24	17.64	22.68	50.96[1]
Vicksburg	31.08	27.72	25.48	21.00	25.48	54.32[1]
Natchez	32.76	29.96	27.72	23.80	27.16	56.56[2]

Source: Tennessee Valley Authority, Knoxville, Tennessee.

[1] Cairo, Ill., Combination; flat rate to St. Louis, coarse grain scale beyond.

[2] St. Louis, Mo., Combination; flat rate to St. Louis, coarse grain scale beyond.

Table 10.—Grain handling charges in cents per bushel, Alabama State Docks, Mobile, 1959.

Type of carrier	Handling charges Receiving by[1]	Delivering to
	(cents)	
Cars	1.5	.75
Barges	1.5	.75
Vessels	1.5	.75
Trucks	2.0	.75

Source: Alabama State Docks Department, **Public Grain Elevator Tariff No. 1-A** (Mobile, Alabama, 1959).

[1] Includes storing 10 days and insurance.

Mississippi should or would necessarily originate at Evansville, but this procedure was used only as a means of determining a specific area in Mississippi that would be affected by the waterway. Prices at receiving points on the Mississippi were then compared with prices at receiving points on the Tennessee-Tombigbee and Warrior-Tombigbee.

Delineation of the Mississippi Area to be Affected

It was assumed that truck would be the most feasible means of transporting grain from barge points. The transportation function, $Y = 5.31662 + .024718X$,[9] where Y represents cents per bushel and X distance in miles, was used in conjunction with prices at receiving points in order to determine the boundary of the area affected by the waterway. P_1 and P_2 were used to represent prices at points on the Mississippi River and prices at points on the Tennessee-Tombigbee Waterway, respectively. Distances which grain would move from Mississippi River receiving points and Tennessee-Tombigbee receiving points were represented by X_1 and X_2, respectively.Then $X_1 + X_2 = T$, or total across-state dis-

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[9] See section pertaining to transportation costs.

Table 11.—Estimated prices of number 2 yellow corn at selected receiving points.[1]

To	From Cincinnati	Louisville	Evansville	Cairo	St. Louis	Minneapolis
			(Cents per bushel)			
Fulton	132.17	128.69	127.39	129.58	132.08	124.80
Columbus	132.73	129.25	127.95	130.14	132.64	125.45
Demopolis	133.84	130.35	129.06	131.24	133.75	126.56
Mobile	134.42	131.47	130.46	133.10	134.46	127.76
Memphis	129.88	127.44	125.92	128.73	129.92	122.92
Greenville	131.56	129.12	127.60	128.73	131.60	124.85
Vicksburg	132.38	129.94	128.42	129.96	132.42	125.66
Natchez	133.19	130.24	129.00	130.55	133.00	126.28

Source: Tables 5, 6, 7, and 10.

[1] Selling price at shipping point plus barge transportation cost plus handling charge to put corn in elevator at receiving point.

tance between receiving points (Appendix C, Table 10). Values of X_1 and X_2 were found by simultaneous solution of the equations:

$$X_1 + X_2 = T$$

$$a + bX_1 + P_1 = a + bX_2 + P_2$$

The boundary of the area affected by the waterway was located by identifying points which could receive corn at an equal price from points on the Mississippi and from points on the Tennessee-Tombigbee. Sufficient comparisons were made to plot the boundary of the affected area. Since feed-grain production data and data for estimating utilization were on a county basis, if grain users in half or more of the land area of a county could receive corn cheaper over the waterway, the entire county was considered to be affected by it. Otherwise, the county was assumed to be unaffected. Twenty seven counties in the eastern part of the state were included as the ones primarily affected by the waterway (Figure 2).

EFFECTS OF THE WATERWAY UPON GRAIN AND LIVESTOCK PRODUCTION AND GRAIN MARKETING

Grain Movements in the Affected Area[10]

Corn and oats were the only grains shipped from other states into the area affected by the waterway in 1959 and 1960 (Table 12). Corn purchases from other states for this area exceeded 1.7 million bushels in 1959 and 2 million bushels in 1960 and represented approximately 15 percent of Mississippi's corn in-shipments during these years. All of the corn moving into the affected area came from the Midwest with Illinois being the most important source. Truck was the primary mode of transportation involved in these movements (Table 13). Again, purchases received by truck from Memphis were considered as moving by barge from the Midwest (Table 14). No in-shipments by rail were reported for this area in 1959 and 1960.

Oat purchases from other states by handlers in the affected area totaled 129 thousand bushels in 1959 and 138 thousand bushels in 1960. This was 12.6 percent of the Mississippi purchases from other states in 1959 and 13.2 percent in 1960. Most of the oat purchases were made in the Midwest with Missouri being the primary source. Both truck and barge were employed in moving oats into the affected area, but truck was the most important.

Grain purchases designated as originating in Mississippi did not necessarily come from within the area affected by

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[10] Includes soybeans.

Table 12.—Out-of-state purchases of grain, by state of origin, Mississippi Area affected by the waterway, 1959 and 1960.

Type of grain and year	State of origin					Total
	Ala.	Ark.	Mo.	Ill.	Midwest[1]	
	(1000 bushels)					
1959						
Corn	----	----	----	602	1,193	1,795
Oats	19	8	25	----	77	129
All grains	19	8	25	602	1,270	1,924
1960						
Corn	----	----	----	748	1,299	2,047
Oats	22	7	29	----	80	138
All grains	22	7	29	748	1,379	2,185

[1] Includes all Midwest grain for which specific origin could not be designated.

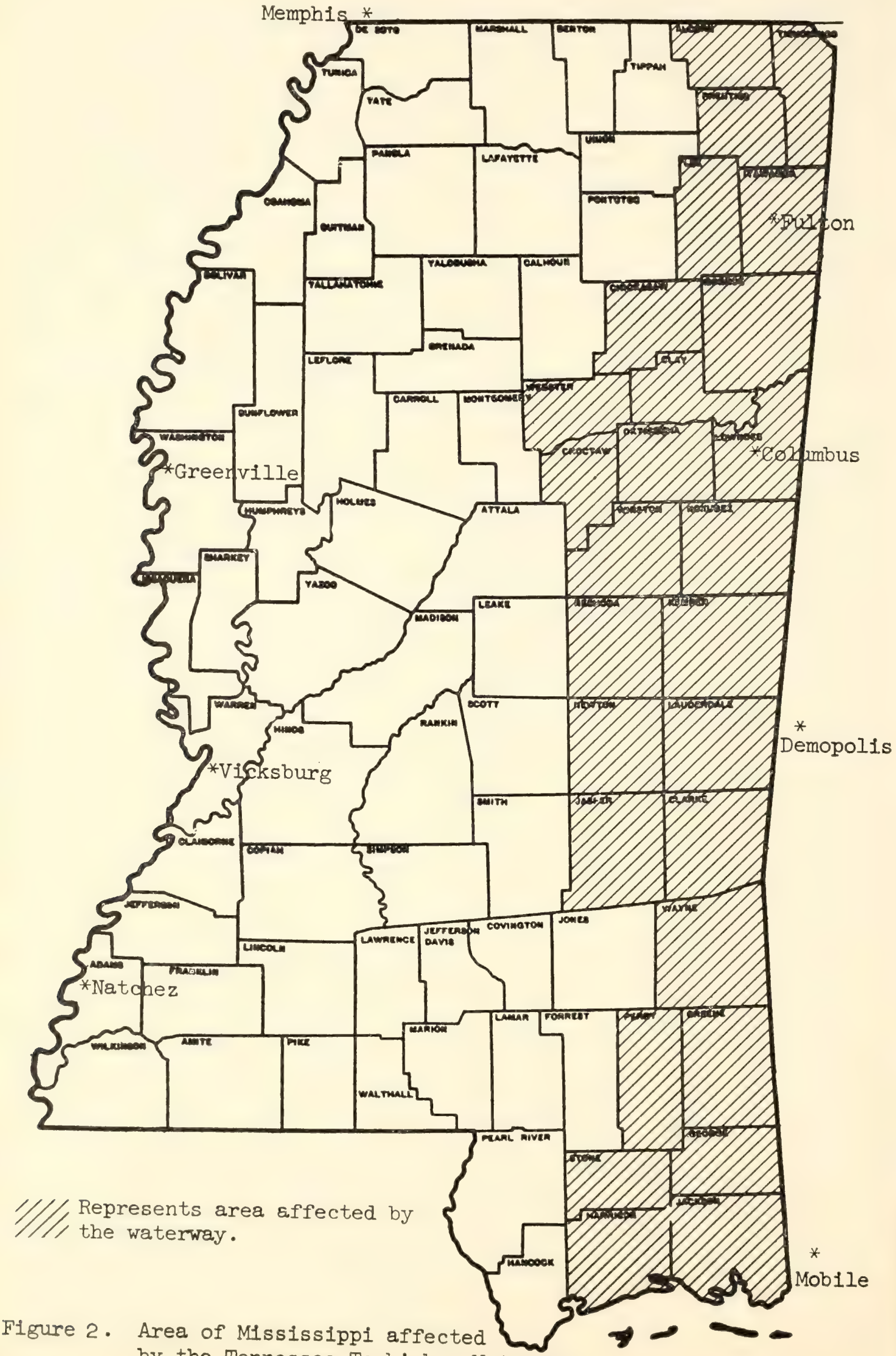
Memphis *
DE SOTO
MARSHALL
BENTON
ALCORN
TISHOMINGO
TUNICA
TIPPAH
TATE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
PONTOTOC
*Fulton
QUITMAN
BOLIVAR
TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
GRENADA
CLAY
LEFLORE
WEBSTER
SUNFLOWER
CARROLL
MONTGOMERY
OKTIBBEHA
LOWNDES
CHOCTAW
*Columbus
WASHINGTON
*Greenville
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
*
Demopolis
*Vicksburg
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
WAYNE
COVINGTON
JONES
JEFFERSON DAVIS
LAWRENCE
LINCOLN
ADAMS
FRANKLIN
*Natchez
LAMAR
FORREST
PERRY
GREENE
MARION
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK
*
Mobile
Represents area affected by the waterway.

Figure 2. Area of Mississippi affected by the Tennessee-Tombigbee Waterway.

Table 13.—Grain purchases moving by truck, by state of origin, Mississippi area affected by the waterway, 1959 and 1960.

Type of grain and year	State of origin								
	Ala.	Ark.	Mo.	Ill.	Midwest[1]	Total out of state	Local[2]	Miss.[3]	Total
					(1000 bushels)				
1959									
Corn	----	----	----	602	584	1,186	886	208	2,280
Oats	19	8	25	----	29	81	93	111	285
Soybeans	----	----	----	----	----	----	408	----	408
All grains	19	8	25	602	613	1,267	1,387	319	2,973
1960									
Corn	----	----	----	748	570	1,318	728	211	2,257
Oats	22	7	29	----	29	87	107	133	327
Grain sorghum	----	----	----	----	----	----	----	7	7
Soybeans	----	----	----	----	----	----	369	----	369
All grains	22	7	29	748	599	1,405	1,204	351	2,960

[1] Includes all Midwest grain for which specific origin could not be designated.
[2] Directly from producers.
[3] Purchased from other firms.

Table 14.—Grain purchases moving by barge, by area of origin, Mississippi area affected by the waterway, 1959 and 1960.

Type of grain and year	Area of origin Midwest	Total
	(1000 bushels)	
1959		
Corn	609	609
Oats	48	48
All grains	657	657
1960		
Corn	729	729
Oats	51	51
All grains	780	780

Table 15.—Soybean out-shipments by rail and truck, by destination, Mississippi area affected by the waterway, 1959 and 1960.

Year and mode	Destination			
	Ala.	Memphis	Export	Total
		(1000 bushels)		
1959				
Rail	----	----	147	147
Truck	213	51	----	264
1960				
Rail	----	----	185	185
Truck	57	----	----	57

the waterway. The specific Mississippi origins of these purchases could not be determined.

Soybeans was the only grain shipped out of the area in 1959 and 1960 (Table 15). Shipments totaled 411 thousand bushels in 1959 and 242 thousand in 1960 and went to Memphis, to Alabama, and for export. All shipments going for export moved by rail, whereas the other shipments moved by truck. Soybean shipments out of the state from this area constituted 6.3 percent of the state shipments in 1959 and only 2.9 in 1960.

Grain Production and Utilization[11]

Production. During the period 1950-1961 grain production fluctuated widely from year to year, but there was no significant trend associated with total grain production (Table 16). Corn, oats, wheat, and grain sorghum were considered in making this analysis, but corn and oats were by far the most important of the four. Since 1950, acreage of corn harvested has continued to decline (Appendix C, Table 11) while production remained at a relatively constant level except for three individual years when production fell below 10 million bushels. Oat acreage and production reached a peak in the mid-fifties, and since that time both acreage and production have declined. Production of wheat and grain sorghum has been small. Acreage and production for both reached a peak in 1957 and 1958, and since that time acreage and production for both have generally been declining.

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[11] Does not include soybeans.

Utilization. In recent years some very noticeable changes have occurred in livestock and poultry production in the affect-

Table 16.—Production of feed-grain, Mississippi area affected by the waterway, 1950-61.

Year	Corn	Oats	Wheat	Grain sorghum	Total
			(1000 bushels)		
1950	16,326	299	5	----	16,630
1951	12,007	197	5	----	12,209
1952	9,120	458	12	----	9,590
1953	10,993	992	36	----	12,021
1954	8,469	1,453	24	----	9,946
1955	14,045	1,318	9	46	15,418
1956	11,917	1,139	15	28	13,099
1957	11,323	881	91	155	12,450
1958	12,903	408	47	190	13,548
1959	10,729	520	26	61	11,336
1960	8,319	472	25	44	8,860
1961	11,796	691	20	50	12,557

Source: Compiled from data published by Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 17.—Livestock and poultry numbers, Mississippi area affected by the waterway, 1950-61.

Feed year[1]	Milk cows 2 yrs. old and over Jan. 1	Heifers and calves kept for milk Jan. 1	Beef cows 2 yrs. old and over Jan. 1	All other cattle Jan. 1	Horses and mules Jan. 1	Hogs fed during feeding year	Hens and pullets Jan. 1	Chickens raised during year	Turkeys raised during year	Broilers raised
					— — — — — 1000 — — — — —					
1950-51	199	135	86	58	110	290	1,877	3,314	46	3,498
1951-52	199	132	111	74	102	282	1,849	3,018	47	4,629
1952-53	206	153	134	98	94	258	1,766	2,474	48	5,510
1953-54	214	152	160	114	88	201	1,607	2,424	50	6,264
1954-55	214	149	187	132	77	222	1,608	2,108	49	6,111
1955-56	215	156	185	133	73	270	1,597	1,962	52	7,843
1956-57	207	150	196	144	65	269	1,573	1,981	54	10,106
1957-58	197	136	194	136	59	251	1,581	2,230	56	12,915
1958-59	180	119	180	119	53	257	1,866	2,656	66	15,687
1959-60	171	123	187	133	46	274	2,382	2,148	53	17,303
1960-61	164	120	190	141	39[2]	230	2,404	2,231	49	19,884

Source: Compiled from data published by Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi and from **Agricultural Statistics,** 1958-61. Where county data were not available state totals were allocated to the area affected by the waterway by percentages computed from 1954 and 1959 census data.

[1] Feed year begins October 1.

[2] Computed from the preivous year by using the average annual change from 1950-51 through 1959-60.

Table 18.—Grain-consuming animal units, by class of livestock, Mississippi area affected by the waterway, 1950-51 through 1960-61.[1]

Feed year	Dairy cattle on Jan. 1[2]	Beef cattle on Jan. 1[3]	Horses & mules on Jan. 1[4]	Hogs raised[5]	Hens & pullets on Jan. 1[6]	Chickens raised[7]	Broilers raised[8]	Turkeys raised[9]	Total
	— — — — — 1000 — — — — —								
1950-51	186	23	209	160	84	50	28	3	743
1951-52	185	30	194	155	83	45	37	3	732
1952-53	195	37	179	142	79	37	44	3	716
1953-54	202	43	167	111	72	36	50	4	685
1954-55	201	51	146	122	72	32	49	3	676
1955-56	203	50	139	149	72	29	63	4	709
1956-57	196	54	124	148	71	30	81	4	708
1957-58	185	52	112	138	71	33	103	4	698
1958-59	168	48	101	141	84	40	125	5	712
1959-60	161	51	87	151	107	32	138	4	731
1960-61	155	52	74	127	108	33	159	3	711

Source: Table 17.

[1] In order to obtain grain-consuming animal units animal numbers were converted to the appropriate form (Table 17) required by R. D. Jennings, **Animal Units of Livestock Fed Annually,** 1909-1955, Agricultural Research Service, United States Department of Agriculture, Statistical Bulletin No. 194, October 1956. Factors for converting animal numbers to grain-consuming animal units were obtained from the same source.

[2] Milk cows two yrs. old and over times .8; heifers and heifer calves kept for milk times .2.

[3] Beef cows two years old and over times .2; all other cattle times .1.

[4] Horses and mules times 1.9.

[5] Hogs raised times .55.

[6] Hens and pullets times .045.

[7] Chickens raised times .015.

[8] Broilers raised times .008.

[9] Turkeys raised times .07.

ed area. Significant shifts in production have taken place among the different classes of livestock (Table 17). Milk cow numbers increased from 1950 through 1956, but since that time there has been a decrease. Beef cow numbers on the other hand, increased from 86 thousand in 1950-51 to 190 thousand in 1960-61. Prior to 1958-59 milk cows outnumbered beef cows, but since that time beef cows have equaled or exceeded the number of milk cows. Broiler production increased from 3.5 million in 1950-51 to approximately 20 million birds in 1961. Horses and mules on farms steadily declined from 110 thousand in 1950-51 to 39 thousand in 1960-61. Production of other classes of livestock fluctuated from year to year, but changes were not so significant as in the classes just discussed.

What effect has this decrease in some classes of livestock and increase in other classes of livestock had on total grain requirements? To answer this question animal numbers were converted to grain-consuming animal units (Table 18). Total animal units during 1950-61 remained relatively stable, dropping below 700 thousand only three times. Thus, shifts in numbers of livestock of the various classes have in themselves had little effect on grain requirements.

While grain-consuming animal units remained relatively stable during the period 1950-61, total concentrates fed per grain-consuming animal unit increased from 1,560 pounds in 1950-51 to 1,960 pounds in 1960-61 (Appendix C, Table 12). While some of this increase can be credited to increased feeding of commercial high-protein feeds, particularly to poultry and hogs, the major part of it has resulted from increased uses of grain in the ration. Jennings estimated that commercial high proteins fed to all classes of livestock made up 9.7 percent of all concentrates fed in 1950.[12] Data published by the American Feed Manufacturers Association indicate that by feed year 1960-61 this percentage had climbed to 12.2.[13] Thus commercial high proteins accounted for only 88 pounds of the 400 pound increase in concentrates fed per animal unit during the period.

Balance between production and utilization. In order to estimate the trend in production and utilization balance, a base period, 1950-52 was established. Grain production (Table 16) and grain requirements (Appendix C, Table 14) from 1953 through 1960 were computed as an index of the base period. Regression analysis of these indexes, made to obtain the average annual change, indicated no significant change in production during the 8-year period. On the other hand, this analysis indicated that from the base period grain requirements had increased approximately 3.2 percent annually (Figure 3).[14] Should these trends continue, the gap between grain production and grain requirements will become larger, and grain purchases from other areas could be expected to become more and more important.

Savings in Transfer Costs Brought About by the Waterway

Without considering the Tennessee-Tombigbee, the least cost mode of transportation to Fulton, Columbus, and Demopolis was truck, with the exception of shipments from Minneapolis, in which barge-truck combination via Mississippi River points was the cheapest. To Mobile and to receiving points on the Mississippi River, barge was the least-cost mode. When shipments over the Tennessee-Tombigbee Waterway were considered, the least-cost mode to Fulton, Columbus, Demopolis, and Mobile was barge. In determining the savings in transfer costs brought about by the waterway, transfer costs after the waterway were subtracted from transfer costs for the least-cost mode of transportation before the waterway. These savings are presented in Table 19. There were no savings in transfer costs to Mobile since barge rates to Mobile were assumed to be the same via the Tennessee-Tombigbee Waterway as by existing water routes prior to the waterway. This was assumed because of the low rates already existing to Mobile by way of the Mississippi River and the intracoastal waterway.

Table 19.—Savings in transfer costs between selected points brought about by the waterway.

From	To Fulton	 Columbus	 Demopolis
	(cents per bushel)		
Cincinnati	10.72	11.37	10.85
Louisville	9.50	10.08	9.92
Evansville	8.92	9.50	10.62
Cairo	6.47	7.02	9.54
St. Louis	8.65	9.21	11.68
Minneapolis	14.10	14.59	14.64

Source: Appendix C, Tables 4, 6, and 8.

Savings shown in Table 19 are savings at particular points and if further transportation, handling, or merchandising charges are involved then these savings would be diminished. For example, if the grain passed through one additional grain handler other than the one at the initial receiving point, this could add an additional 5 cents handling and merchandizing charge. In some cases these additional charges alone would practically eliminate the savings brought about by the waterway. Therefore, it should be emphasized that the extent of savings brought about by the waterway could depend to a large extent upon the number

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[12] Jennings, Ralph D., **Consumption of Feed by Livestock, 1906-56** (United States Department of Agriculture Production Research Report No. 21). (Washington, D. C., 1958), p. 86.

[13] American Feed Manufacturers Association, **Estimated Feed Use and Supplies** (Chicago 4, Illinois, November 1960), p. 6.

[14] The b-value was significant at the one percent level.

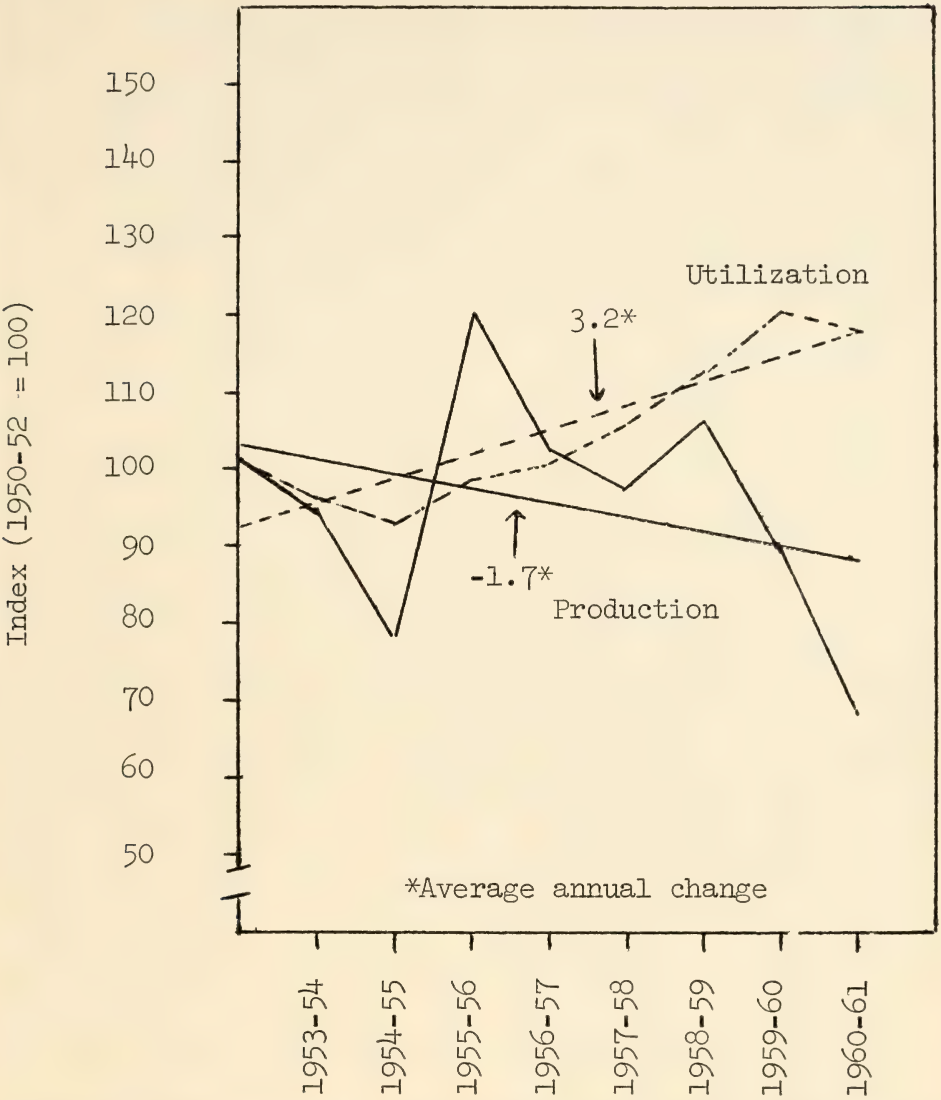


Figure 3.—Feed-grain production and utilization by all classes of livestock in the Mississippi area affected by the Tennessee-Tombigbee Waterway, 1953-61.

Source: Index of production computed from Table 16. Index of utilization computed from Appendix C, Table 14.

Table 20.—Grain elevator facilities costs and cost per bushel of capacity, Corn Belt, 1956.

Size of new concrete elevator	Total facility cost	Equipment cost	Building cost	Cost per bushel of capacity Total	Equip.	Bldg.
(1000 bushels)		(1000 dollars)			(dollars)	
30	59	22	37	1.96	.73	1.23
60	79	20	59	1.31	.34	.98
100	95	22	73	.95	.22	.73
200	138	24	114	.69	.12	.57
400	242	36	206	.61	.09	.52

Source: Thurston, Stanley K., and Mutti, R. J., **Cost-Volume Relationships for New Country Elevators in the Corn Belt** (U. S. Department of Agriculture Farmer Cooperative Service, Service Report 32). (Washington, D. C., September 1957), p. 11.

of middle-men involved after the grain left the initial receiving point.

Effect Upon Livestock and Poultry Production

Data presented earlier indicated that since 1950 both beef cattle and broiler production have been increasing in this area. Many factors will determine whether the livestock and poultry industry in the affected area continues to expand, but since this is a grain deficit area, any reduction in transfer costs for feed-grain in-shipments should be favorable to the user of feed-grain. Therefore, livestock and poultry producers should be in a more favorable competitive position than before. It will now be assumed that the waterway does go into effect, and that the savings presented in Table 19 do become a reality. It will also be assumed that these savings are passed on to the producer in the form of cheaper grain or feed by the full amount of the savings. Savings at particular points ranged from 6.47 cents to 14.64 cents per bushel. With a 6.47-cent per-bushel savings and grain requirements as presented in Appendix C, Table 16, the cost of producing a 3.5-pound broiler could be reduced .66 cents; the cost of producing a 237-pound hog could be reduced $1.17; and the cost of adding 400 pounds of gain to a 750-pound steer could be reduced $2.78. With a savings of 14.64 cents, production costs could be reduced by 1.5 cents per broiler, $2.65 per hog and $6.24 per steer.

Effect Upon Grain Production

While a reduction in transfer charges would most likely be favorable to the user of feed-grain in this area, it would probably put the feed-grain producer in a weaker bargaining position. It should be understood that soybeans were not considered in this section. Prices received by the feed-grain producer would be expected to decline. Any reduction in prices received by farmers should force the more inefficient producers out of production, particularly those producing feed-grain for the market. At a lower price production in the area would be expected to decline and less locally produced feed-grain would be offered for sale, but the users of feed-grain would demand more. Therefore, additional amounts of feed-grain would be required from other areas.

Storage and Marketing Facilities

The immediate effect of the waterway upon livestock and feed-grain production would depend to a great extent upon how rapidly storage and marketing facilities developed along the waterway. This would also affect the immediate potential of the waterway as an outlet for export.

Past studies indicate that storage facilities are available for all grain produced in the area. In 1958 farm storage capacity in the area amounted to 21.7 million bushels (Appendix C, Table 17), and available commercial storage totaled 1.2 million bushels. Production of all grain totaled 14.5 million bushels the same year (Tables 16 and 21).

The extent and size of new facilities developing along the waterway will depend primarily upon the volume of grain moving by barge into or out of the tributary area, and the expected volume to move through the facility in the long run. Elevator facilities require a large cost outlay and the returns are spread over many years. Table 20 gives some indication of the cost of new elevator facilities in the Corn Belt in 1956. These figures should apply to a certain extent for grain facilities developing along the waterway, and they also give some indication of the relationship between building and equipment cost and volume.

With facilities developing along the waterway, many of the small grain facilities in the area affected by the waterway would most likely go out of business. The larger users of grain would conceivably by-pass grain facilities located inland and deal directly with facilities located on the waterway. Therefore, the tendency should be toward fewer and larger facilities.

Out-shipments through marketing facilities seem to be confined primarily to the soybean industry. Mississippi exports substantial quantities of soybeans, and they have become one of the major cash crops. This is particularly true in the Mississippi Delta, and several counties in the northeastern section of the state. In the counties expected to be affected by the waterway, soybean production more than doubled in 10 years and exceeded 1 million bushels in 1961 (Table 21). Yield per acre for the more prominent soybean-producing counties in this area compares favorably with the yields in the Delta counties. In a previous discussion it was noted that soybeans was the only grain shipped out of this area in 1959 and 1960 (Table 15). The beans that were not shipped for export went to Alabama or Memphis, and could have easily gone for export from these locations.

Based on the consumption of soybean meal per grain-consuming animal unit for all classes of livestock (Appendix C, Table 15), soybean production in this area is not sufficient to meet soybean meal requirements. There is only one soybean processing plant in the area, and indications are that it is not processing nearly enough soybean meal to meet the requirements. However, whether the soybeans produced in the area would go for export or would be processed into soybean meal and consumed in the area would depend upon a number of factors. Since some of the soybeans produced in the area are presently going for export, there is no reason to believe that this would be discontinued. If soybean production in the area continues to increase as it has in the past, then exports from this area might be expected to increase.

Table 21.—Soybean acreage and production, Mississippi area affected by the waterway, 1950-61.

Year	Acres harvested for beans	Production
		(bushels)
1950	20,910	403,800
1951	25,380	327,485
1952	23,830	316,580
1953	21,600	268,400
1954	15,000	178,150
1955	23,300	433,800
1956	27,800	452,100
1957	36,700	687,800
1958	45,900	979,500
1959	50,600	784,000
1960	48,100	1,043,200
1961	48,900	1,095,875

Source: Compiled from data published by Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Shipping soybeans from northeast Mississippi to Gulf ports by barge, rather than by rail or truck, could result in savings of as much as 5 to 6 cents per bushel. The rail rate from Booneville, a town in one of the area's leading soybean-producing counties, to ports on the Gulf is approximately 11 cents per bushel. Booneville is about the same distance from the Gulf as Fulton. Computed rates from Fulton to Mobile are 6.2 cents by barge and 11.44 cents by truck. None of these rates, however, include merchandising and handling charges. Actual savings would be dependent upon the number of times the grain was handled in association with each mode of transportation.

APPENDIX A

Table 1.—Truck shipments of out-of-state grain to Mississippi handlers, by state of origin, 1959 and 1960.

	State of origin								
Type of grain and year	Ala.	Ill.	Ind.	Mo.	Midwest[1]	Texass	Other Western States	Other[2]	Total
					(1000 bushels)				
1959									
Corn	----	2,722	354	1,090	2,026	----	----	----	6,192
Oats	19	----	----	25	29	----	----	8	81
Wheat	----	----	----	----	----	----	----	100	100
Grain sorghum	----	----	----	----	----	14	235	----	249
Soybeans	----	----	----	----	----	----	----	1,319	1,319
All grains	19	2,722	354	1,115	2,055	14	235	1,427	7,941
1960									
Corn	----	2,990	354	1,212	2,152	----	----	----	6,708
Oats	22	----	----	29	29	----	----	7	87
Wheat	----	----	----	----	----	----	----	145	145
Grain sorghum	----	----	----	----	----	----	235	50	285
Soybeans	----	----	----	----	----	----	----	1,033[3]	1,033
All grains	22	2,990	354	1,241	2,181	----	235	1,235	8,258

[1] Includes all Midwest grain for which specific origin was not designated.

[2] Includes movements for which specific origins could not be disclosed.

[3] Includes a small amount moving by train from Tennessee that could not be published separately.

Table 2.—Rail shipments of out-of-state grain to Mississippi handlers, by state of origin, 1959 and 1960.

	State of origin					
Type of grain and year	Tenn.	Ill.	Mo.	Neb.	Other[1]	Total
			(1000 bushels)			
1959						
Corn	662	38	146	----	----	846
Oats	199	----	----	27	----	226
Grain sorghum	----	----	----	----	208	208
All grains	861	38	146	27	208	1,280
1960						
Corn	648	39	227	----	----	914
Oats	164	----	----	33	----	197
Grain sorghum	----	----	----	----	3	3
All grains	812	39	227	33	3	1,114

[1] Includes movements for which specific origins could not be disclosed.

Table 3.—Barge shipments of out-of-state grain to Mississippi handlers, by state of origin, 1959 and 1960.

Type of grain and year	State of origin[1]					Total
	Ill.	Ind.	Minn.	Mo.	Midwest[2]	
			(1000 bushels)			
1959						
Corn	2,024	85	1,641	1,237	----	4,987
Oats	----	----	----	----	717	717
Wheat	----	----	----	----	----	----
Grain sorghum	----	----	----	----	32	32
Soybeans	----	----	----	----	----	----
All grains	2,024	85	1,641	1,237	749	5,736
1960						
Corn	3,974	195	1,368	977	----	6,514
Oats	----	----	----	----	754	754
Wheat	----	----	----	----	42	42
Grain sorghum	----	----	----	----	620	620
Soybeans	----	----	----	----	261	261
All grains	3,974	195	1,368	977	1,677	8,191

[1] The specific origins of barge movements of Midwest gain to Mississippi were not designated. The corn designated as moving from the Midwest by barge was allocated to states of origin on the basis of data published by the Corps of Engineers in **Waterborne Commerce of the United States**, supplement to part 5, National Summaries, 1959 and 1960. Barge receipts at selected Mississippi River Ports from selected shipping areas were used to make allocations. The receiving area included ports from the mouth of the Ohio River to but not including Baton Rouge. The shipping areas included Minneapolis, Minn., to mouth of Missouri River and Minnesota River; mouth of Missouri River to mouth of Ohio River; Ohio River; and Illinois River.

[2] Includes Midwest grain for which specific origin was not designated or could not be disclosed.

Table 4.—Volume of grain out-shipments, by destination, by type of grain, Mississippi, 1959 and 1960.

Type of grain and year	Destination						Total
	Ala.	La.	Tenn.	Southeast[1]	Gulf for export	Other[2]	
			(1000 bushels)				
1959							
Corn	----	690	----	----	----	102	792
Oats	159	253	197	98	----	50	757
Wheat	48	----	----	----	417	23	488
Barley	----	----	54[3]	----	----	----	54
Grain sorghum	----	----	3	----	----	----	3
Soybeans	775	----	473	----	5,257	----	6,505
All grains	982	943	727	98	5,674	175	8,599
1960							
Corn	----	841	----	----	----	95	936
Oats	144	149	494	121	----	47	955
Wheat	72	----	----	----	588	37	697
Barley	----	----	71[3]	----	----	----	71
Grain sorghum	----	----	----	204	----	----	204
Soybeans	533	----	527	----	7,057	----	8,117
All grains	749	990	1,092	325	7,645	179	10,980

[1] Includes all out-shipments to the Southeast for which specific destinations were not designated.

[2] Includes out-shipments for which sepcific destinations could not be disclosed.

[3] Includes a small quantity shipped to Texas which could not be published separately.

Table 5.—Grain out-shipments: Volume moving by each mode of transportation, by type of grain, Mississippi, 1959 and 1960.

Type of grain and year	Truck	Rail	Rail and Barge[1]	Total
	(1000 bushels)			
1959				
Corn	723	69	----	792
Oats	583	174	----	757
Wheat	10	61	417	488
Barley	54[2]	----	----	54
Grain sorghum	----	3[3]	----	3
Soybeans	287	985	5,233	6,505
All grains	1,657	1,292	5,650	8,599
1960				
Corn	866	70	----	936
Oats	786	169	----	955
Wheat	20	89	588	697
Barley	71[2]	----	----	71
Grain sorghum	204	----	----	204
Soybeans	84	997	7,036	8,117
All grains	2,031	1,325	7,624	10,980

[1] Barge and rail shipments combined.

[2] Includes a small quantity moving by rail which could not be published separately.

[3] Includes a small quantity moving by truck which could not be published separately.

APPENDIX B

METHOD OF COMPUTING BARGE RATES FOR THE PROPOSED TENNESSEE-TOMBIGBEE WATERWAY

Barge rates published by Arrow Transportation Company of Sheffield, Alabama, were used for all barge movements except those involving movements on the Tennessee - Tombigbee Waterway. These rates are the lowest published in common carrier barge line tariffs on file with the Interstate Commerce Commission. Published barge rates were not available for the Tennessee - Tombigbee Waterway, therefore, it was necessary to compute rates. First, six river points in the North Central Region and four Tennessee River points were selected. Barge rates between North Central Region points and Tennessee River points were taken from Arrow Transportation Company's published rates (This Appendix, Table 1). A regression analysis of rate to distance (This Appendix, Tables 1 and 3) indicated that there was a high degree of relationship between distance and barge shipping rate in this case. An r-value of .98 was obtained which indicated that over 96 percent of the variation in rate was explained by distance. The b-value was significant at the 1 percent level. Results of this regression indicated that barge rates could be represented by the function $Y = 2.24977 + .0086432X$, where Y represented cents per bushel and X represented distance in miles.

Waterway distances between the North Central Region points and the Tennessee River points (This Appendix, Table 3) correspond very closely to distances between these same North Central Region points and selected points on the Tennessee - Tombigbee and Warrior Tombigbee Waterways (This Appendix, Table 2). Also the number of locks and dams involved are approximately the same. In the 647 miles along the Tennessee River from Paducah to Knoxville there are nine locks and dams. In the 685 miles from Paducah to Mobile by way of the Tennessee - Tombigbee there will be twelve locks and dams. Locks on the waterway will be comparable in size to those on the Tennessee River and those already existing on the Warrior-Tombigbee Waterway. With these similarities it was felt that the rate structure for the two water routes should be comparable. Therefore, the distances presented in this Appendix, Table 2 and the function Y = 2.24977 + .0086432X were used to compute rates for the proposed Tennessee - Tombigbee Waterway.

Table 1.—Barge rates for corn between selected points via Tennessee River, January, 1962.

From	To Sheffield	Guntersville	Chattanooga	Knoxville
	(cents per bushel)			
Cincinnati	08.04	08.57	09.60	11.68
Louisville	07.45	07.98	09.02	11.09
Evansville	05.38	05.91	06.94	09.02
Cairo	05.80	06.33	07.36	09.44
St. Louis	06.16	06.69	07.73	09.80
Minneapolis	12.46	12.99	14.03	16.10

Source: Arrow Transportation Company, **Guide to Published Barge Rates on Bulk Grain** (Schedule No. 3). (Sheffield, Alabama, January, 1962).

Table 2.—Waterway distances between selected points via Tennessee-Tombigbee Waterway.

From	To Fulton	Columbus	Demopolis	Mobile
	(miles)			
Cincinnati	743	808	936	1,153
Louisville	571	636	764	981
Evansville	421	486	614	831
Cairo	327	392	520	737
St. Louis	501	566	694	911
Minneapolis	1,173	1,238	1,366	1,583

Source: U. S. Army Corps of Engineers, **Restudy of Tennessee-Tombigbee Waterway.**

Table 3.—Water distances between selected points via Tennessee River.

From	To Sheffield	Guntersville	Chattanooga	Knoxville
	(cents per bushel)			
Cincinnati	723	827	932	1,115
Louisville	551	655	760	943
Evansville	401	505	610	793
Cairo	307	411	516	699
St. Louis	481	585	690	873
Minneapolis	1,153	1,257	1,362	1,545

Source: U. S. Army Corps of Engineers, **Restudy of Tennessee-Tombigbee Waterway.**

APPENDIX C

Table 1.—Trucking rates and associated distances for corn movements within and to Mississippi, 1960.

Rate	Distance
(cen per bushel)	(miles)
5	36
5	38
5	42
6	47
5	69
6	71
5	76
11	82
7	100
7	102
8	111
7	116
7	124
8	122
8	130
14	171
10	182
14	188
11	212
13	228
10	300
17	323
17	323
14	450
15	456
12	505
22	600
22	600
18	621
23	639
24	681
24	689
24	690
22	691
23	700
23	702
23	708
24	755
28	1,061

Source: Rates were obtained from grain handlers within Mississippi. Distances were taken from pertinent road maps.

Table 2.—Corn: Season average price received by farmers in selected states, 1956-60.

Year	Missouri	Ohio	Indiana	Illinois
		(cents per bushel)		
1956-57	132	128	127	131
1957-58	112	119	111	115
1958-59	111	111	111	113
1959-60	105	104	103	106
1960-61[1]	100	90	90	93

Source: **Agricultural Statistics, 1958-61.**

[1] Preliminary.

Table 3.—Corn, number 2 yellow: Season average price at selected points, 1956-60.

Year	Cincinnati	Louisville	Evansville	Cairo	St. Louis	Minneapolis
1956-57	129	129	128	132	133	122
1957-58	137	125	127	133	129	112
1958-59	124	120	124	126	124	110
1959-60	118	115	116	120	119	107
1960-61	103	111	103	106	114	102

Source: St. Louis and Minneapolis prices from **Grain Market News**, United States Department of Agriculture, Agricultural Marketing Service, Grain Division, Volume 9, No. 40, Washington, D. C., October 6, 1961. Louisville prices for 1956-57 and 1957-58 from Feedral State Market News Service, Louisville 18, Ky., quoted in Phillips, Travis D., "A Spatial and Seasonal Analysis of Corn Prices in North Carolina." These Louisville prices were approximately 97 percent of St. Louis prices and this relationship was assumed for computing Louisville prices for the other three years. In computing prices for Cairo, Cincinnati, and Evansville, Missouri corn prices received by farmers for the period 1959-60 were used as a base (This Appendix, Table 2). Prices received in Illinois, Indiana, and Ohio for the same period were computed as an index of Missouri prices. These same relationships were assumed to hold between St. Louis prices and prices at Cairo, Evansville, and Cincinnati. With this assumption prices at Cairo, Evansville, and Cincinnati were computed from St. Louis prices.

Table 4.—Transfer cost for corn between selected points involving barge-truck combination via points on the Mississippi River.[1]

	From					
To	Cincinnati	Louisville	Evansville	Cairo	St Louis	Minneapolis
			(cents per bushel)			
Fulton via Memphis	21.61	21.17	19.65	19.46	19.65	25.65
Columbus via Memphis	22.75	22.31	20.79	20.60	20.79	26.79
Columbus via Greenville	24.38	23.94	22.42	20.55	22.42	28.67
Demopolis via Greenville	26.75	26.31	24.79	22.59	24.79	31.04
Demopolis via Vicksburg	25.92	25.48	23.96	22.50	23.96	30.20
Mobile via Vicksburg	26.83	26.39	24.87	23.41	24.87	31.11
Mobile via Natchez	27.94	26.99	25.75	24.30	25.75	32.03

[1] Transportation cost plus 7cents handling and merchandising charge on receiving end.

Table 5.—Transfer cost between selected points for corn moving by rail.[1]

	From					
To	Cincinnati	Louisville	Evansville	Cairo	St. Louis	Minneapolis
			(cents per bushel)			
Fulton	28.66	25.30	22.50	16.34	23.06	49.66
Columbus	28.66	25.86	23.06	16.90	23.62	50.22
Demopolis	29.78	26.98	25.86	21.38	26.98	54.70
Mobile	33.14	30.90	29.78	26.42	30.90	59.74
Memphis	25.86	21.94	18.02	12.98	18.02	44.90
Greenville	30.34	27.54	24.74	19.14	24.18	52.46
Vicksburg	32.58	29.22	26.98	22.50	26.98	55.82
Natchez	34.26	31.46	29.22	25.30	28.66	58.06

[1] Transportation cost plus 1.5 cents handling charge on receiving end.

Table 6.—Transfer cost between selected points for corn moving by truck.[1]

	From					
To	Cincinnati	Louisville	Evansville	Cairo	St. Louis	Minneapolis
			(cents per bushel)			
Fulton	20.89	18.19	16.31	13.05	16.73	30.75
Columbus	22.10	19.33	17.45	14.16	17.85	31.86
Demopolis	22.69	20.27	19.68	17.75	21.43	35.45
Mobile	25.86	23.43	22.84	19.70	23.38	37.40
Memphis	20.37	17.40	14.04	11.47	15.08	28.85
Greenville	23.98	21.01	17.65	15.08	18.69	31.79
Vicksburg	25.83	22.86	19.50	16.93	20.54	34.04
Natchez	28.40	26.70	21.21	18.64	22.25	35.74

[1] Transportation cost plus 2 cents handling charge on receiving end.

Table 7.—Transfer cost between selected points for corn moving by barge via Mississippi River.[1]

From	To Memphis	 Greenville	 Vicksburg	 Natchez	 Mobile
			(cents per bushel)		
Cincinnati	07.88	09.56	10.38	11.19	12.42
Louisville	07.44	09.12	09.94	10.24	11.47
Evansville	05.92	07.60	08.42	09.00	10.46
Cairo	05.73	05.73	06.96	07.55	10.10
St. Louis	05.92	07.60	08.42	09.00	10.46
Minneapolis	11.92	13.85	14.66	15.28	16.76

[1] Transportation cost plus 1.5 cents handling charge on receiving end.

Table 8.—Transfer cost between selected points for corn moving by barge via Tennessee-Tombigbee Waterway.[1]

From	To Fulton	 Columbus	 Demopolis	 Mobile
		(cents per bushel)		
Cincinnati	10.17	10.73	11.84	12.42
Louisville	08.69	09.25	10.35	11.47
Evansville	07.39	07.95	09.06	10.46
Cairo	06.58	07.14	08.24	10.10
St. Louis	08.08	08.64	09.75	10.46
Minneapolis	13.80	14.45	15.56	16.76

[1] Transportation cost plus 1.5 cents handling charge on receiving end.

Table 9.—Road miles from selected points in the North Central United States to selected points in the Southeast.

To	From Cincinnati	 Louisville	 Evansville	 Cairo	 St. Louis	 Minneapolis
			(miles)			
Fulton	549	440	364	232	381	948
Columbus	598	486	410	277	426	993
Demopolis	622	524	500	422	571	1,138
Mobile	750	652	628	501	650	1,217
Memphis	528	408	272	168	314	871
Greenville	674	554	418	314	460	990
Vicksburg	749	629	493	389	535	1,081
Natchez	853	784	562	458	604	1,150

Source: U. S. Atlas and other pertinent road maps.

Table 10.—Road miles from selected points on the Mississippi River to selected points on the Tennessee-Tombigbee and Warrior-Tombigbee Waterways.

From	To Fulton	 Columbus	 Demopolis	 Mobile
		(miles)		
Memphis	118	146[1]	248	380
Greenville	191	162	196[1]	303
Vicksburg	241	187	191	228
Natchez	310	256	254	240

Source: Road maps of Mississippi and Alabama.

[1] Represents a straight line distance.

Table 11.—Acreage of feed grains, Mississippi area affected by the waterway, 1950-61.

	Corn		Oats	Wheat	Grain sorghum
Year	Acres harvested, all purposes	Acres harvested for grain	Acres harvested	Acres harvested for grain	Acres harvested for grain
1950	703,500	----	13,530	240	----
1951	610,500	----	9,110	180	----
1952	586,100	----	13,350	450	----
1953	518,100	----	25,170	1,350	----
1954	537,100	----	42,360	840	----
1955	528,400	509,400	44,780	390	2,400
1956	525,700	500,700	35,500	540	1,560
1957	497,300	471,300	31,500	4,905	5,160
1958	459,800	440,000	14,650	3,000	6,720
1959	416,100	392,900	16,650	1,245	1,958
1960	382,400	359,000	13,450	1,195	1,246
1961	328,300	318,400	17,900	845	1,424

Source: Compiled from data published by Mississippi Crop and Livestock Reporting Service, Jackson, Miss.

Table 12.—Concentrates fed per animal unit, United States, 1950-51 through 1960-61.

Feed year[1]	Concentrates fed
	(tons)
1950-51	.78
1951-52	.80
1952-53	.78
1953-54	.80
1954-55	.78
1955-56	.80
1956-57	.82
1957-58	.88
1958-59	.92
1959-60	.96
1960-61	.98[2]

Source: Hodges, Earl F., **Animal Units of Livestock Fed Annually 1909 to 1960** (U. S. Department of Agriculture, Economic Research Service Statistical Bulletin No. 301). (Washington, D. C., 1961), p. 19.

[1] Feed year begins October 1.

[2] Preliminary estimate.

Table 13.—Grain as a percentage of all concentrates fed to all classes of livestock, United States, 1950-51 through 1960-61.

Feed year[1]	Percent
1950-51	90.3
1951-52	90.3
1952-53	89.6
1953-54	89.7
1954-55	90.0
1955-56	89.8
1956-57	89.3
1957-58	88.8
1958-59	88.5
1959-60	88.7
1960-61	87.8

Source: 1950-51 through 1956-57 from Jennings, Ralph D., **Consumption of Feed by Livestock,** 1909-56, p. 86; 1957-58 through 1960-61 from **Estimated Feed Use and Supplies,** 1957-61.

[1] Feed year begins October 1.

Table 14.—Total concentrate requirements and total grain requirements by feed year, Mississippi area affected by the waterway, 1950-51 through 1960-61.

Feed year	Concentrate requirements[1]	Grain requirements[2]
	(tons)	
1950-51	580	524
1951-52	586	529
1952-53	558	500
1953-54	548	492
1954-55	527	474
1955-56	567	509
1956-57	581	518
1957-58	614	545
1958-59	655	580
1959-60	702	623
1960-61	697	612

[1] Animal units in Table 18 times concentrates fed per animal unit in this Appendix, Table 12.

[2] Concentrate requirements times percent of grain in total concentrate requirements presented in this Appendix, Table 13.

Table 15.—Soybean meal: Consumption per grain-consuming animal unit for all classes of livestock, United States, 1950-58.

Year beginning October 1	Consumption per animal unit
	(Pounds)
1950	68.0
1951	76.5
1952	69.4
1953	63.4
1954	67.2
1955	73.0
1956	87.7
1957	98.6
1958	104.3

Source: Phillips, Travis D. and Jacks, Barney H., **An Analysis of Soybean Marketing Trends in Mississippi**, p. 23.

Table 16.—Estimated grain required to produce broilers, hogs, and slaughter steers to specific market weights, feed-year 1961-62.

Type of livestock	Market weight	Grain required
	(pounds)	(pounds)
Broilers	3.5	5.7[1]
Hogs	237	1,019[2]
Slaughter steers	1,150[3]	2,400

Source: American Feed Manufacturers Association, **Estimated Feed Use and Supplies**, November, 1961.

[1] Includes an allowance for feedlot wastage.

[2] Includes feed for the breeding herd and feedlot wastage.

[3] 750-pound steer plus 400 pounds of gain.

Table 17.—Capacity of grain storage facilities on farms, by crop reporting distrirts, Mississippi and area affected by the waterway, June, 1958.

District	Mississippi	Area affected by the waterway[1]
	(1000 bushels)	
1	8,340	----
2	7,160	----
3	8,590	5,369
4	11,270	----
5	9,185	1,837
6	8,510	8,510
7	5,815	----
8	6.700	----
9	8,210	6,018
Total	73,780	21,734

Source: Wells, Chester M., Jr. and Jacks, Barney H., **Grain Marketing problems in Mississippi** (Mississippi State University Agricultural Experiment Station Bulletin 601). (State Collgee, Mississippi, 1960). p. 21.

[1] Capacity of grain storage facilities in area affected by the waterway computed by multiplying .625 times total grain storage capacity in district 3, .200 times total grain storage capacity in district 5, 1.00 times total grain storage capacity in district 6, and .733 times total grain storage capacity in district 9.

BULLETIN 664 APRIL 1963

Improved Forage Box

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

MITCHELL MEMORIAL LIBRARY
MISSISSIPPI STATE UNIVERSITY

IMPROVED FORAGE BOX

By T. N. JONES, AGRICULTURAL ENGINEER

Better methods and equipment are necessary for continued economical improvement of the livestock program in Mississippi.

Equipment for moving forage from the field to green feeding or storage is available from many sources today. One thing the user must determine is shall the equipment be used for silage handling only, or shall it be used in more than one type of forage production.

The forage box presented here includes refinements and improvements made by the Agricultural Engineering Department of the Mississippi Agricultural Experiment Station. It can be built at home if facilities are available or in a shop equipped for this type of construction. This plan is designed to produce a forage box capable of lasting a minimum of ten years, therefore the initial cost is higher than some designs but the maintenance is low, thus the overall cost is very reasonable.

The box may be used on several types of vehicles, such as the four-wheel trailer or trucks. If the four-wheel trailer is used it should be of a heavy type as the box has a capacity of five to six tons of green forage. Normally the forage is unloaded by a gear reduction box[1] driven with one-third H.P. electric motor. If mounted on a truck the forage may be unloaded with power from the truck power take-off.

The Bed

This bed which is 7'8" wide and 14' long is strong enough to carry a normal size tractor, yet flexible enough to fit most jobs on the livestock farm. The bed is welded and therefore stiff. It should be fastened to the trailer at two places only, one on front bolster and the other on rear bolster on opposite side from the front. It is not recommended to put this type bed on a trailer which has springs.

It is necessary that the trailer be coupled to proper length and that the cross pieces of channel iron be placed so that the wheels of the trailer will be free at all times. The two-inch floor should be bolted to the three-inch channel cross pieces, with a 3/16" X 3" strap on top of the wood around the edge. This metal strap will protect the edge of the wood permitting longer life for the bed.

Sides of Box

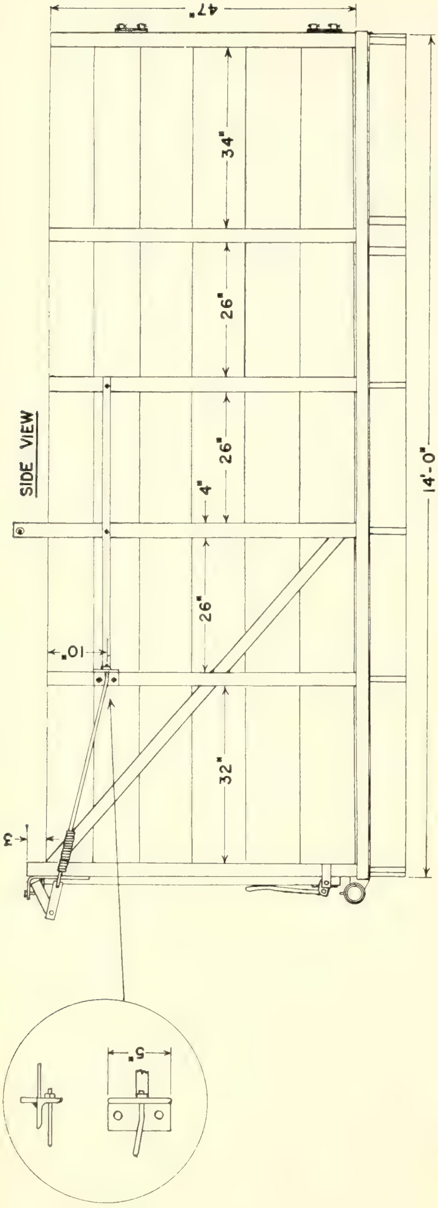
The sides of the forage box are 4' X 14' with standards which fit between metal straps on the bed. The plan shows one standard 55" high with a ½" rod through the standards, and a pipe over the rod on the inside of the standards. This prevents the sides from moving in when empty and out when full. Some types of harvesters have larger fans than others; it may be desirable to have the back four standards 55" high and use one-inch hardware cloth around the top to prevent the forage being blown over top of bed.

End Gates

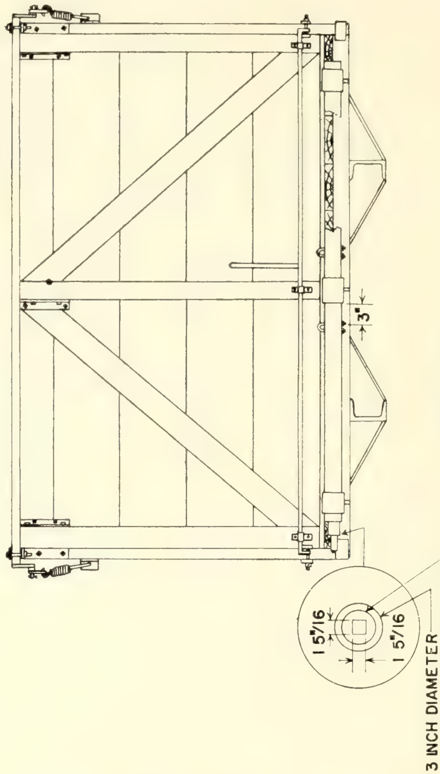
Front: The front end gate is constructed to slide on the floor of the forage box bed and pull the forage out of the trailer. This is done by cables fastened to the end gate and the pipe mounted on

---

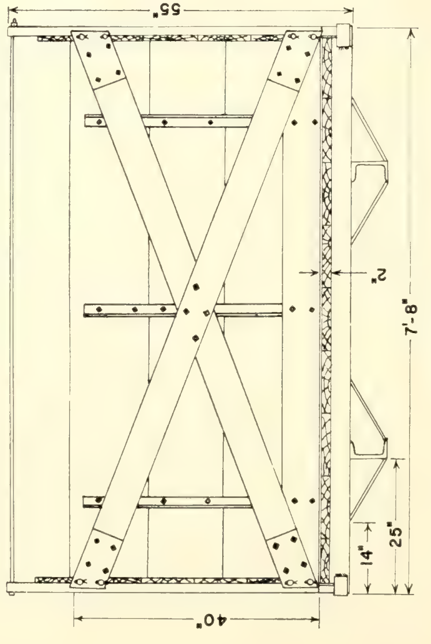
[1] Gear reduction boxes are available from Claffey Machine and Manufacturing Company. Grovesport, Ohio.


47"
34"
26"
26"
4"
26"
10"
32"
3 1/2
14'-0"
5"

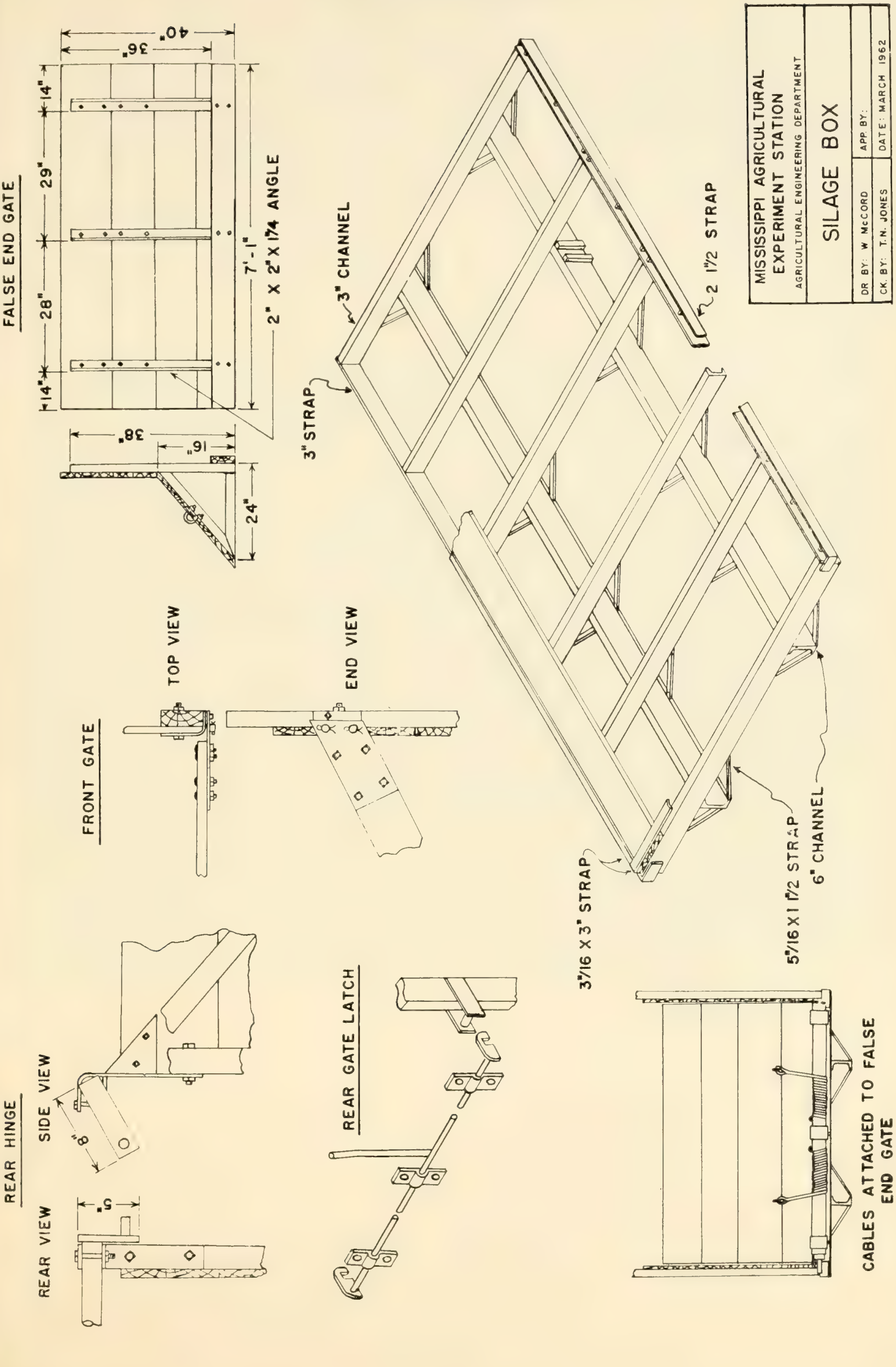
SIDE VIEW


3"
1 5/16
1 5/16
3 INCH DIAMETER
2 1/4 INCH DIAMETER

REAR VIEW

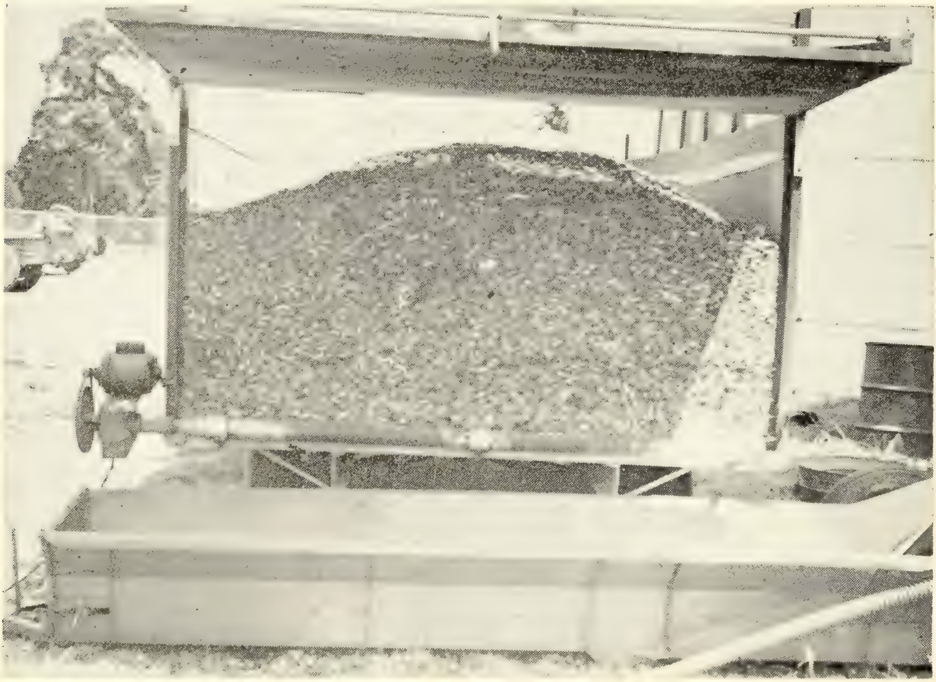

55"
2"
7'-8"
14"
25"
40"

FRONT VIEW


FALSE END GATE
40"
36"
14"
29"
28"
14"
7'-1"
2" X 2" X 1/4 ANGLE
38"
16"
24"
FRONT GATE
TOP VIEW
END VIEW
3" CHANNEL
3" STRAP
2 1 1/2 STRAP
3/16 X 3" STRAP
5/16 X 1 1/2 STRAP
6" CHANNEL
REAR HINGE
REAR VIEW
SIDE VIEW
8"
5"
REAR GATE LATCH
CABLES ATTACHED TO FALSE END GATE
MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
AGRICULTURAL ENGINEERING DEPARTMENT
SILAGE BOX
DR BY: W. McCORD
APP BY:
CK. BY: T.N. JONES
DATE: MARCH 1962

the rear of the trailer. As the reduction gear box pulls the false front-end gate to the rear the forage is pulled out the rear of the trailer. The front-end gate may be moved back to the front of the trailer by hand after the trailer is empty and the reduction gear box removed. It is advisable to have a catch on the front end gate otherwise it will slide while in transport when empty.

Rear: The rear end gate is swung at the top of the trailer and counter balanced with springs so that it will stay in a horizontal position while unloading. Therefore, to open or close a given amount of pull is required. This is a very desirable feature both from safety and time saved. The latch on bottom of gate is home made and functional. If the gate is latched and ring placed over the handle it cannot come loose.



BILL OF MATERIALS

Metal

		Weight	Length	Total Needed
Bed				
2 pc.	6" channel	standard	14'	28'
6 pc.	3" channel	standard		
2 pc.	3/16" x 3" strap		14'	28'
2 pc.	3/16" x 2½" strap		14'10"	29'8"
30 pc.	3/16" x 2½" x 2" strap		2"	5'
18 pc.	5/16" x 1½" x strap			12"
2 pc.	1/8" x 3" x 88"			
2—4"	U-bolts 3/8" x 1½" to hold cables			4
2—5/16"	cable clamps			
2 pc.	5/16" cable		13'	26'
1 pc.	3" O.D. double strength pipe		7'	7'
1 pc.	2½" shaft with end machined to 1-5/16" square for gear reduction fitting			12"
3 pc.	3" I.D. pipe X 4"			12"
2	springs for rear door tractor mower springs		5/16" x 20"	
2 pc.	strap 1/8" x 1½" x 60"		60"	10'
Bed				
2 pc.	rod ½" x 28"		28"	5"
2 pc.	strap ½" x 2" x 5"			
2 pc.	strap 3/8" x 1½" x 15"			
2 pc.	strap ¼" x 1½" x 7¼"			
2 pc.	strap ½" x 2" x 7"			
2 pc.	U 3/8" x 1½" x 3"			
3 pc.	angle 1½" x 9"			
1 pc.	pipe 3/4" I.D.		89¼"	89¼"
3 pc.	strap clamp for 3/4" pipe 1/8" x 1½" x 3½"			12"
1 pc.	pipe 3/4" I.D.		12"	12"
False end gate				
3 pc.	angle 2" x 2" x ¼"		22½"	72"
3 pc.	angle 2" x 2" x ¼"		24"	72"
3 pc.	angle 2" x 2" x ¼"		40"	120"
Front gate				
4 pc.	strap or plates 6" wide x 8" on one side by 10" on other side x ½"			
4 pc.	angle 4" x 4" x ½" x 1 3/4" bolts hole for cotton key, welded to angle to hold X front gate on			
Bolts				
As needed				

Wood

Cresoted	Popular or other suitable material (rough)
8 pc 2" x 8" x 14'	6 pc 1"x 8" x 14'
1 pc 2" x 12" x 14'	1 pc 2" x 6" x 85"
Oak	2 pc. 1" x 5" x 91½"
2 pc 1 3/4" x 3" x 58"	6 pc 1" x 12" x 85"
10 pc 1 3/4" x 3" x 52½"	8 ps 1" x 12" x 88"
2 pc 1 3/4" x 3" x 40"	1 pc. 1" x 6" x 88"
2 pc 1 3/4" x 3" x 33"	2 pc 1" x 6" x 60"
	1 pc 1" x 4" x 55"

BULLETIN 665 MAY, 1963

THE HOSPITAL AND ITS PUBLIC RELATIONS

By
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THE HOSPITAL AND ITS PUBLIC RELATIONS*

INTRODUCTION

Since the enactment of the National Hospital Survey and Construction Act of 1946 (Hill-Burton) more than 80 Mississippi communities have built hospitals and health centers. Some of these were built to replace or complement existing but inadequate facilities. However, most of them were built in communities where no hospital had previously operated.

Many of these new hospitals have experienced a great degree of success in meeting community health needs. Others have experienced varying types and degrees of organizational and administrative problems, including among other things: low rates of occupancy, high rates of staff turnover, heavy charity loads, and in some cases maladministration. Equally as important also has been the failure of some communities to accept the hospital as a part of the institutional structure of the community and to support it in the same sense that the schools, churches and other institutions are supported.

The Problem

This paper reports the findings of a study which was conducted in an effort to determine the acceptance of new Hill-Burton hospitals by the communities in which they have been built. The purposes of the study were: (1) to determine the acceptance of hospitals by their various publics in the community, and (2) to arrive at criteria or standards that could be used by hospital administrators and other hospital personnel for establishing a program of favorable public relations between the hospital, its several publics, and the community at large.

The assumption upon which the study was based was that the hospital as a local institution has a number of different kinds of publics with which it must maintain favorable relationships if it is to render maximum service to the community. The following groups were assumed to be publics of the local hospital: (1) the board of trustees and other governing bodies, (2) personnel employed by the hospital, (3) the medical staff, (4) patients and other persons using the hospital's services, (5) social, public and voluntary agencies, (6) key or prominent people in the community, e.g., the important local leaders, (7) the general public interested in community welfare, (8) the larger general public and (9) the people and groups instrumental in establishing and developing the hospital.

The significance of this type of study was shown when leaders in the hospital field began to look closely at the problems confronting some of the new hospitals in Mississippi. It was first thought that many of the problems of Mississippi hospitals were financial and could be solved through such things as increased use, better billing and collecting procedures, and lower charity loads. However, a closer examination of the problem indicated that it was in part sociological, that in some cases, the new hospitals had failed to become integrated into the institutional structure of the community, that in some instances the hospital did not enjoy the support that the other institutions in the community did; and that gaining this support was dependent upon the establishment of favorable relationships with each of the hospital's publics in the community.

The Design

In keeping with the stated purposes of the study a five-year schedule was established and the study was divided into three phases which were accomplished in succession. The first phase was largely exploratory and was concerned with an analysis of the available statistical data on the general service hospital of 25 or more beds within the state. These data included

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*This study was supported by a research grant, W-46, from the National Institutes of Health, Division of Research Grants, U. S. Public Health Service.

information on the hospitals which was on file with the Mississippi Hospital Association, data supplied by the hospitals to the American Hospital Association, and census materials on the county in which the hospitals were located. These data were examined in light of the social, economic and demographic data on the counties in which the hospitals were located. In addition to permitting the testing of several hypotheses with respect to hospital-community relations, the data indicated the number and types of hospitals, trends in the increase of hospitals and hospital beds since 1950, and the size of hospitals in relation to occupancy, length of hospitalization, and hospital costs.

The second phase of the study was concerned with the public relations of hospitals and their administrators. During this phase data were collected from a majority of hospital administrators in the state, either by personal interview or mailed questionnaires. These data were concerned with the history of the hospital, its present status, its equipment, its activities, its personnel, personal and professional characteristics of the administrator, and the administrator's relationships with the board of trustees.

The analysis of these data was made in terms of characteristics of hospitals and administrators which were related to the public relations of hospitals. Prior to the collection of the data the hospitals in the state had been rated as to the quality of their public relations by six persons in public and private agencies whose daily work brought them in close contact with hospitals throughout the state. They were asked to rate the public relations of each general short-term hospital in Mississippi with 25 or more beds, as being either "very good", "good", "average", "poor", or "very poor". This resulted in fifteen hospitals being classified as "good" to "very good", and sixteen as "poor" to "very poor". Sixty-two remaining hospitals received mixed ratings.

Hospitals rated as "good" to "very good" with respect to their public relations were compared with those whose public relations were rated as "poor" to "very poor." This analysis permitted the testing of several hypotheses with respect to the characteristics of hospitals and the role of the administrator in the public relations of the hospitals, and helped set the stage for the final phase of the study.

The final phase of the study consisted of intensive case studies of three hospitals. These were chosen so as to represent three distinct types insofar as the hospital's relationships with its publics were concerned. Personal interviews were conducted with the administrator, the staff, the board of trustees, a representative sample of former and potential patients, and where applicable, members of the hospital auxiliary. The interviews were designed to show the relationship of the hospital with each of these publics and to discern factors in the past and present which might help explain the relationship. It is desirable to examine the findings of the two early phases of the study before proceeding to the discussion of the case studies. The following section, therefore, considers pertinent data on the hospitals and on the hospital administrators in the state.

Characteristics and Trends of Mississippi Hospitals

In 1957 Mississippi had a total of 6,566 short term hospital beds in 114 short term general hospitals and 21 limited service clinics and hospitals.[1] These facilities were located in 72 counties. Short term general hospitals had an average of 55 beds and the limited service clinics and hospitals averaged 12 beds.

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[1] For a more comprehensive discussion of the characteristics of Mississippi hospitals see, J. V. D. Saunders, and J. H. Bruening, **Mississippi Hospitals, 1957 Characteristics and Trends**, Mississippi Agricultural Experiment Station Bulletin 564, State College, 1958, and J. V. D. Saunders and J. H. Bruening, **Hospital Care in Mississippi**, Mississippi Agricultural Experiment Station Information Sheet 581, State College, 1958. By 1961 the number of hospitals and of hospital beds in short term general hospitals had increased to 142 and 8,189 respectively. **Mississippi State Plan for Construction of Hospitals and Medical Facilities**, publication of Mississippi Commission on Hospital Care, Jackson, Mississippi.

Almost 80 percent of the short term general hospitals were publicly owned and over 70 percent of the limited service clinics and hospitals were privately owned.

From 1950 to 1957 the number of county (Hill-Burton) hospitals increased from 15 to 48. During this time the number owned by nonprofit associations decreased slightly, and the number owned by church bodies, corporations and the state remained largely unchanged.

The number of hospital beds increased from 1950 to 1957 by 35 percent. Of more significance, however, is the fact that the number of "acceptable" beds increased by 51 percent during this time while non-acceptable beds increased by less than one percent.

Nearly two-thirds of Mississippi hospitals and clinics had fewer than 50 beds during 1957. However, less than one-third of the beds devoted to short term care in hospitals were in these smaller hospitals. Only 11 percent of Mississippi hospitals, on the other hand, had 100 or more beds, but these accounted for more than one-third of the short term hospital beds. The larger general hospitals also contained more equipment and staff to perform more complicated procedures. This is reflected in the fact that these hospitals handled nearly as many admissions as the smaller hospitals; that the length of stay in these hospitals was longer than in the smaller ones; and that the average cost per patient in hospitals of 100 or more beds was $110.00 compared to an average cost of $53.37 in hospitals with fewer than 25 beds and an average cost of $63.42, $68.33, and $91.33 for patients in hospitals with 25-49 beds, 50-74 beds and 75-99 beds, respectively.

As would be expected most of the hospitals were located in small towns. Communities with fewer than 2,500 persons contained two-fifths of the hospitals, but only one-fifth of the beds. Communities with fewer than 10,000 persons contained two-thirds of the hospitals and clinics and two-fifths of the beds. Cities of 50,000 or more population had only 4.4 percent of the state's hospitals, however, these hospitals contained 13.2 percent of the beds.

Characteristics of Hospitals and Hospital-Community Relations

One of the first tasks in the study was to discover the relationship between characteristics of hospitals and the hospitals' relations with their publics. This analysis was made with data which had been supplied by the hospitals to the American Hospital Association and with other available data on hospitals in the state. Due to the nature of the available data this part of the study was primarily concerned with the relationship between the characteristics of hospitals and their relationship with the larger general public or community at large. The analysis was made only for hospitals with 25 or more beds, as it was thought that the smaller hospitals and clinics would be atypical of the general hospitals in the state.

The first consideration in the analysis was with the characteristics of hospitals and of hospital communities which were related to community relations of hospitals.[2] The analysis was made by comparing the characteristics of hospitals which had been judged by the panel of judges to have good community relations with those of hospitals which had been judged to have poor community relations. An examination of the data showed:

(1) Whether the hospital's community relations were "good" or "poor" did not depend upon the percent of occupancy of the hospital, nor the average length of stay for patients.

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[2] See: J. V. D. Saunders and J. H. Bruening, "Hospital - Community Relations in Mississippi", **Rural Sociology**, 24 (1959), pp. 48-51; J. V. D. Saunders, "Characteristics of Hospitals and of Hospital Administrators Associated with Hospital - Community Relations in Mississippi", **Rural Sociology**, 25 (1960), pp. 229-232, and Marion T. Loftin, "Hospital Public Relations in Mississippi—Good or Bad?" Paper read at the meetng of the Mississippi Hospital Association. Biloxi, Mississippi, October 8, 1959.

(2) Hospitals with good community relations did not necessarily have a low cost per patient and show a profit.

(3) Hospital-community relations were not related to the proportion of bills paid by hospital insurance.

(4) The number of facilities per bed was not related to the community relations of hospitals.

(5) The percentage of increase in bed size was not related to the community relations of hospital.

(6) The size of the hospital community and its location in the state was not related to the hospital's community relations.

(7) The average income of families and unrelated individuals in the hospital community was not related to the hospital's community relations.

(8) Hospital-community relations were not related to the racial and residential composition of the county's population in which the hospital was located.

Characteristics of hospitals which were related to the hospital's community relations were:

(1) **Age of hospital** — The hospitals which received a high rating in community relations were considerably newer than the low rated hospitals.

(2) **Type of ownership**—A much higher percentage of the high rated hospitals than of the low rated ones were publicly owned.

(3) **Percentage of bills paid by state and charitable organizations** — Low rated hospitals did very little charity work compared to the high percentage of charity care rendered by high rated hospitals.

(4) **Method of founding** — Hospitals founded by M.D.'s were generally rated low in community relations by the panel of judges. Most high-rated hospitals were founded by leaders from the community at large.

(5) **Size of hospital and of hospital community** — Although size of the hospital and of the hospital community were not significantly related to the hospital's community relations, there was a tendency for high rated hospitals to be above average in size and located in the larger communities. This also meant that these hospitals were better equipped, had higher cost per patient, the average length of stay in these hospitals was longer, and in most cases these hospitals had a staff which could handle a wide variety of cases and procedures.

The Hospital Administrator and Hospital-Community Relations

In the early stages of the study it was hypothesized that the hospital administrator is the key person in the promotion of the hospital among its several publics. Three events led to the formulation of this hypothesis. The first was a preliminary survey of a sample of hospital administrators designed to ascertain their conceptions of hospital-public relations and the type of public relations programs which the administrators had. Forty-five administrators were asked to participate, but only 21 cooperated to the extent that they supplied the information requested.

The information supplied showed that the administrators had fairly clear conceptions and programs of effective relations with the board of trustees, the medical staff, personnel employed by the hospital, and with patients and other persons using the hospital. However, very few had clear concepts of public relations with other publics, namely the social, civic and public agencies, the community power group, the general public interested in social welfare, the larger general public and the persons instrumental in founding and developing the hospital.

The second event which gave rise to the belief that the administrator is the key figure in promoting the hospital occurred when the statistical data from the American Hospital Association were analyzed. Administrators of hospitals whose public relations were rated as "good" to "very good" supplied most of the information asked for by this agency. Administrators of hospitals whose public relations were rated as "poor" to "very poor" supplied considerably less. The most unpopular items of information among the latter group had to do with costs and length of stay. There is reason to believe that many of the administrators of the low rated hospitals either did not have this information or were not interested enough to supply it. Either might be construed as an indication of poor administration.

A rating of hospital administrators by a panel of judges according to the quality of their public relations, and its comparison with the quality of the hospitals' public relations was the third event which contributed to the belief that the administration is the key figure in promoting the hospital in the community. This comparison showed that all administrators of hospitals which had been rated low in public relations also received ratings on their public relations as only "fair" or "poor". On the other hand, administrators of all hospitals which were considered to have good public relations received ratings of good.

It was therefore decided to examine more closely the role of the administrator in the hospital's public relations. This involved the collection of data on administrators and comparing characteristics of administrators of hospitals rated high in public relations with the characteristics of those rated low. As in the previous analysis, these data were primarily concerned with the administrators' relations with the large general public or community at large.

The analysis showed that several characteristics of administrators were not related to the rating on public relations which their hospitals had received. These were: marital status, number of children, occupation of father, whether or not the administrator was a native of the community in which he works, and whether he was educated in or out of the state.

Several of the characteristics of administrators did prove to be related to their rating on public relations. These were as follows:

(1) **Type of job training**—almost all of the administrators of high rated hospitals had had training in hospital administration. Only one administrator of a low rated hospital had had such an experience.

(2) **Professional identification**—administrators of high rated hospitals generally identified with only one profession, administration. About one-half of the administrators of low ranked hospitals were M.D.'s and identified professionally with medicine as well as administration.

(3) **Salary** — administrators of high rated hospitals received higher salaries than administrators of low rated hospitals. The median annual salary of the first group of administrators was $8,500; for the second group it was less than $5,000.

(4) **Job mobility** — administrators of high rated hospitals had changed jobs more frequently than administrators of low rated hospitals with reference to non-hospital jobs. When only hospital jobs were considered, however, the administrators of low rated hospitals had changed jobs more frequently.

(5) **Participation in professional organizations** — the participation of administrators of high rated hospitals in professional organizations far outweighted the participation of administrators of low rated hospitals as measured by the number of organizational memberships and the number of offices held.

(6) **Participation in community organizations** — administrators of high rated hospitals participated in an average of three community organizations and held two offices in these organizations. Administrators of low rated hospitals belonged to an average of two community organizations and held one office.

As previously stated the first two phases of the study were intended to set the stage for the final phase by suggesting hypotheses which would be examined more closely when case studies were conducted of different hospital situations. However, before the third phase of the study is discussed it is desirable to state the tentative conclusions which were drawn from the earlier phases and to examine these conclusions in light of their practical significance to the hospital service industry.

The statistical data have suggested that the quality of public relations of hospitals is largely dependent upon factors which are not necessarily connected with the hospital itself, but reside wihin the realm of "human" factors. It is reasonable to assume that these factors may not be the same in every situation. Therefore, it is the responsibility of the administrator who is concerned about the future of his hospital to discover what these factors are and to manipulate them to his hospital's advantage.

For example, the data showed that the quality of public relations of hospitals taken as a group is not related to percent of occupancy, average length of stay per admission, percent of bills paid by hospital insurance, number of facilities per bed, percent of increase in bed size, size and location of hospital community, racial and ethnic composition of hospital community, nor the average income of families in the community. This does not mean, however, that each or any combination of these factors may not be important considerations in individual hospitals. The efficient administrator should, of course, make an effort to discover when any of these factors play a role in the successful operation of his hospital.

The data do show that the quality of the public relations of hospitals taken as a group is related to the age of the hospital, type of ownership, method of founding, percent of bills paid by state and charitable organizations and size of hospitals. The typical hospital in Mississippi with good public relations is thus seen as a rather new hospital, founded by a group of community leaders, which handles a sizeable charity load, and is above average in size.

One cannot conclude from these data, however, that this unique combination of features will predispose good public relations. The examination of data on hospital administrators lends credence to the belief that the fate of the hospital lies largely in the hands of its administrator, at least insofar as public relations are concerned. The data show, for example, that marital status, number of children, occupation of father, community of birth, and place of education for the administrator have no relationship to the quality of the hospital's public relations. But, the administrators of hospitals whose public relations are good are professionally trained hospital administrators, who identify with the profession of hospital administration only, who have stayed in hospital jobs for long periods before changing jobs and participate in a number of professional and community organizations. Each of these factors is in part "human related" and would lead one to believe that the more efficient hospital administrators are cognizant of the "human element" in their job.

There are, of course, other important factors which operate to influence the prestige of the hospital in the community. The above discussion has largely ignored such things as history of the hospital, doctor-hospital relations, the relationship between the hospital administrator and the governing board of the hospital, the expectation of the community with respect to the hospital, and the support which the community is willing to lend to all of its institutions. This complex of factors provides an environment which acts to strengthen or weaken the administrator in his attempts to make his hospital an integral part of the social structure. In the following section consideration will be given to the role of some of these factors in the public relations program of the local hospital when the three case studies are discussed.

ATTITUDES TOWARD THE LOCAL HOSPITAL

The Local Hospital

In this section attention is directed to some findings of the case studies conducted in three hospital communities. One aspect of the case studies involved the measurement of attitudes toward each hospital as expressed by the larger general public in the hospital service area and by former patients of the hospital and their families. It is with this measure of acceptance that the following section will be concerned.

The three hospitals studied exhibited certain distinctive characteristics as well as some characteristics which were common to all hospitals. Each was a relatively new Hill-Burton unit, and each was located in a town of 10,000 or less population. Hospital One was located in South Mississippi in a cotton-truck farming area. Hospital Two was located in Northwest Mississippi in a part hill-part Delta county, and Hospital Three was located in Northeast Mississippi in a cotton-dairy county. There was a relative lack of industry in each county.

The Method

The method employed in this aspect of the study was to observe the attitudes of a sample of white housewives in each county toward the hospital, and to search for factors which might explain the attitudes. Two types of attitudes were tapped. All persons interviewed were asked a series of questions designed to indicate general attitudes toward the hospital. When placed on a continuum these attitudes ranged from thinking about the hospital as a part of the community to its actual support through use contributions, etc. It was felt that these attitudes would indicate general acceptance of the hospital as a part of the community, and these attitudes were used to construct a hospital acceptance index.

If a respondent or some member of their family had used the hospital, a series of questions designed to measure satisfaction with selected aspects of the hospital was asked. These more specific attitudes were combined into an index of hospital satisfaction and introduced as a independent variable in an effort to discern a possible relationship between general acceptance of the hospital and satisfaction with the way the hospital had performed its services.

The Sample

The county is the unit on which the hospital must ultimately depend for support. Therefore, the county was considered the hospital community for the purposes of this study. Persons who were interviewed in each county were chosen when houses were picked randomly from existing road maps of the county so as to yield approximately 30 white households in each of the five beats of the county. Negroes were not included because of their relative lack of use of hospitals, and because of their lack of involvement in community decision making. The sampling ratio varied for each beat depending upon its population characteristics and location. In some beats practically all white housewives were interviewed. Thus, according to rigorous sampling models the sample was an accidential one. However, a comparison of the samples with the county population on selected characteristics showed that the samples were representative of the general county population.

The Hospital Acceptance Index

The hospital acceptance index was constructed from answers to the nine questions designed to elicit general attitudes toward the hospital. The nine questions together with the way they were interpreted were as follows:

(1) What institutions in this community are you proud of? (List in order of rank)
If the hospital was mentioned as one of the first three it was assumed that this was a favorable attitude toward the hospital.

(2) If you were asked to show a visitor or one of your friends the institutions which make this community

a good place in which to live what would you show them? (List in order of rank)

If the hospital was mentioned as one of the first three it was assumed that this was a favorable attitude toward it.

(3) From what you know about hospitals in other communities how do you think the local hospital compares with the others in general appearance? Why?

Better or as good indicated a favorable attitude toward the hospital.

(4) How do you think the local hospital compares with these same hospitals from the point of view of services offered, equipment, etc.? Why?

Better or as good indicated a favorable attitude toward the hospital.

(5) Let's suppose I'm a complete stranger in this area, and I ask you to recommend a hospital for a gall-stone condition, which hospital would you recommend I use? Why?

Mention of the local hospital indicated acceptance of the hospital.

(6) If you discovered that you or some member of your family had a serious heart condition which hospital would you use? Why?

Mention of the local hospital indicated acceptance of the hospital.

(7) If the county tried to float a bond issue for the hospital to use in improving its plant or services would you vote for it? Why?

Yes indicated acceptance of the hospital.

(8) If you had surplus produce from your garden and decided to give it away what would you do with it?

If respondent indicated she would consider giving it to the hospital it was assumed this indicated acceptance of the hospital.

(9) If you had some spare time that you wanted to use to help out in a worthy cause what would you likely volunteer to do? (List in order of preference)

If this hospital was mentioned it was assumed that this indicated a favorable attitude toward it.

Responses to each of these attitude items were recorded for each individual and an item analysis was conducted to determine if the attitudes could be combined into an index of acceptance of the hospital.[3] Scoring of attitudes was dichotomous. Each attitude of acceptance received a score of one, and attitudes which did not indicate acceptance received a score of zero.

The item analysis showed that seven of the attitudes were scalables.[4] Only items eight and nine, those having to do with contributions of surplus produce and free time, did not meet the criteria for the index of acceptance. Thus, on the basis of the seven-item index, each person could receive a possible score of from zero to seven on the acceptance index.[5]

Findings

The scores of respondents on the index of acceptance showed that the hospitals enjoyed rather wide acceptance as measured by the number of favorable attitudes expressed. See Table 1. The largest number of attitudes of acceptance was expressed

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[3] A system of trace line analysis was used for the item analysis. This involves four basic steps: (1) assigning weights to each attitude item, (2) calculation of scores for each item and a total score, (3) correlating the total score with scores on each item, and (4) plotting the scores to observe direction of the relationship. For a description of this method see J. H. Copp, "Trace Line Analysis, An Improved Method of Item Analysis", unpublished manuscript, University Park, Pennsylvania, 1959.

[4] A more comprehensive discussion of the method used to construct this index is contained in Gerald O. Windham and Marion T. Loftin, "Factors Associated with Public Acceptance of a New Hill - Burton Hospital", **Rural Sociology**, 26 (1961), pp. 418-422.

[5] This index is believed to be logically valid. However, further use of it is necessary in order to establish its reliability and validity. A recent study in which the hospital acceptance index was used showed that actual use of the hospital and scores on the acceptance index were significantly associated. See: Vaughn Leroy Grisham, Jr., "Hospital - Community Relations in Rural County, Mississippi", unpublished Master's thesis, Mississippi State University, 1961.

Table 1. Distribution of scores on the hospital acceptance index.

Scores on the Acceptance Index	Hospital 1 N = 152 Percent	Hospital 2 N = 152 Percent	Hospital 3 N = 150 Percent	All Hospitals N = 454 Percent
0	1	3	5	3
1	7	4	7	6
2	11	12	13	12
3	20	11	22	18
4	28	15	21	21
5	20	19	19	20
6	9	16	9	12
7	4	19	4	9

toward Hospital two. Only thirty percent of the respondents in the county in which Hospital Two was located made scores of three or less on the hospital acceptance index. This compared to 47 percent of the respondents in the county in which Hospital Three was located, 39 percent of the respondents in the county in which Hospital One was located, and 39 percent of all respondents. These findings agreed with previous findings in the overall project which had indicated that Hospital Two's public relations programs were superior to those of Hospital One and Three.

The relationship between scores on the hospital acceptance index and several objective factors were observed. Factors which were significantly associated with this index are discussed below under: (1) personal and class related factors, (2) contact with the hospital, and (3) personal influence.[6]

Personal and Class Related Factors

There was no significant association between scores on the hospital acceptance index and age of respondent, stage in the family life cycle, size of family, type of work in which engaged, tenancy status, and number of meetings attended monthly for persons in all of the hospital communities. However, age was significantly associated with hospital acceptance scores for persons in the county where Hospital Two was located. The relationship was negative. Two possible explanations for this relationship were observed. There was a tendency for a preponderance of older persons to express loyalty to a hospital and physicians in an adjoining county. Also a large proportion of older persons felt that they might need charity care if they were to use a hospital, and they thought it would not be easily obtained at Hospital Two.

The other personal and class related factors which were significantly associated with acceptance in some or all of the hospital communities are discussed below.

Level of Living: Level of living was significantly associated with scores on the hospital acceptance index for the total sample.[7] There was no consistent relationship between scores on the hospital acceptance index and scores on the level of living index. However, there was a tendency for the relationship to be negative. See Table 2.

An examination of the level of living scores and hospital acceptance scores for respondents in each of the three hospital communities showed that there was a significant association between these variables for respondents in the counties in which hospitals One and Two were located. In County One the relationship was curvilinear, indicating that the hospital enjoyed the greatest relative degree of acceptance among those who were average on level of living. This appeared to be related also to the hospital's history and to its present policy with respect to charity care. This hospital is new and before it was opened persons went outside the county for hospital service. Many substantial middle class families have continued this practice because of their loyalty to physicians located in areas outside the county. Also this hospital is located near a regional state charity hospital. As a result Hospital One has refused charity patients. Thus, the element of the county population which depends upon charity care is by necessity oriented away from Hospital One.

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[6] For more information on this phase of the study see: Gerald O. Windham, Elisabeth J. Stojanovic, and Marion T. Loftin, **Attitudes Toward a New Hill - Burton Hospital in a Northeast Mississippi County;** Mississippi Agricultural Experiment Station, Preliminary Report in Sociology and Rural Life No. 16, State College, 1961; Windham, Stojanovic, and Loftin, **Attitudes Toward a New Hill - Burton Hospital in a South Mississippi County,** Mississippi Agricultural Experiment Station, Progress Report in Sociology and Rural Life No. 18, State College, 1961; and Stojanovic, Windham, and Loftin, "Acceptance of a New Hill - Burton Hospital by Residents of a Northwest Mississippi County", Mississippi Agricultural Experiment Station Information Sheet 698, State College, 1961.

[7] Level of living was measured by a nine item index consisting of: bathroom, automatic washer, telephone, separate freezer, vacuum cleaner, hardwood floors, separate dining room, subscription to a daily newspaper, and subscription to two or more popular magazines. These items were selected from a universe of level of living items by item analysis and are internally consistent. See previous note on trace line analysis for a description of the item analysis model used.

The relationship between level of living scores and hospital acceptance scores for respondents in the county in which Hospital Three was located was positive. Scores on the hospital acceptance index increased consistently with scores on the level of living index at all levels. Although there was no significant association between levels of living scores and hospital acceptance scores in the county in which Hospital Two was located there was a tendency for these factors to be negatively correlated. This in turn appeared to be related to a number of class related items, such as income, education, tenure status, and place of residence in the county. This is a part hill, part Delta county, and the highest level of living was reported by planters in the latter part of the county. As a rule the planters have expected a large amount of charity care for their croppers and laborers. The hospital has not always honored these requests, and the planters as a result tend to show antogonism toward it.

Total Family Income: Total family income was significantly associated with scores on the hospital acceptance index. As with the level of living index there was no clearly discernable positive or negative relationship between the two variables. See Table 3. A classification of respondents in each county by scores on the hospital acceptance index and total family income showed that these variables were significantly associated in each of the three counties. For Hospital One there was a curvilinear relationship for these variables and persons with the lowest and highest income expressed the smallest number of favorable attitudes toward the hospital. Income and hospital acceptance scores were negatively related in the county where Hospital Two was located and, were positively related for respondents in Hospital Three's county. Thus, as would be expected the relationship between income and hospital acceptance is the same as the relationship between level of living scores and hospital acceptance scores

Table 2. Classification of respondents by hospital acceptance scores and level of living scores.*

Level of Living Scores	Hospital Acceptance Scores		
	0 - 2 Percent N = 94	3 - 4 Percent N = 177	5 - 7 Percent N = 183
0 - 2	22	27	28
3 - 5	33	29	30
6 - 9	45	44	43

*P = .001 as indicated by Kruskal - Wallis analysis of variance model.

Table 3. Classification of respondents by total family income and scores on the hospital acceptance index.*

Total Family Income	Hospital Acceptance Scores		
	0 - 2 Percent N = 94	3 - 4 Percent N = 177	5 - 7 Percent N = 183
0 - 999	16	22	15
1,000 - 2,999	26	24	30
3,000 - 4,999	23	24	26
5,000 - Over	35	30	29

*P = .05 as indicated by Kruskal - Wallis analysis of variance model.

in each of the counties. The possible explanation for each relationship is also the same.

Last Grade of School Completed: There was no significant association between scores on the hospital acceptance index and last grade of school completed for all respondents. However, there was a tendency for persons who were average in education to make higher scores on the hospital acceptance index. See Table 4. Education and scores on the hospital acceptance index were significantly associated among respondents in the counties where Hos pitals One and Three were located. In Hospital One's county these variables were positively related and the number of favorable attitudes expressed toward the hospital increased consistently as education increased. The same relationship was observed in the county in which Hospital Three was located even though the relationship was not statistically significant.. In the county where Hospital Two was located there was a negative relationship between education and scores on the hospital acceptance index. This was not surprising in view of the tendency for all class related factors to be negatively related to hospital acceptance scores in this county.

Formal Social Participation: Formal participation is a class related factor as well as a communication medium. Therefore, if other class related factors are related to hospital acceptance one would hypothesize that formal participation is also. Number of meetings attended monthly and number of power positions held in voluntary associations were not related to scores on the hospital acceptance index for the total sample. However, there was a significant association between number of organization memberships and hospital acceptance scores. Unlike other class related factors the relationship was positive. See Table 5. There was also a tendency for these variables to be positively related in each of the hospital communities. The role of social participation in promotion of the hospital needs to be examined more closely. Social participation will, therefore, be discussed again in a subsequent section.

Health Consciousness: Although health consciousness was not significantly associated with scores on the hospital acceptance index for the total sample, these variables were significantly associated for each of the samples when they were considered separately.[8] Also there was a discernable positive relationship between these variables for the total sample. As the number of recommended health practices followed by respondents in the total sample increased so did the proportion of persons making higher scores on the hospital acceptance index. See Table 6. Thus, as would be expected, those persons who are most concerned with health as indicated by their behavior in following recommended health practices have the most favorable attitudes toward their own county hospital.

Table 4. Classification of respondents by formal education and scores on the hospital acceptance index.*

Last grade of school completed	Hospital Acceptance Scores 0 - 2 Percent N = 94	 3 - 4 Percent N = 177	 5 - 7 Percent N = 183
Under 8	29	35	26
8 - 12	46	46	53
13 - 15	15	14	14
16 and over	11	5	7

*Not statistically significant.

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[8] Health consciousness was inferred from a health practice index consisting of immunization shots within the past year, dental check-up within the past six months, complete medical examination within the past year, and chest X-ray within the past six months. These items were selected by item analysis and are internally consistent. The association between scores on the health practice index and scores on the hospital acceptance index was significant at $P = .05$ for Hospital One, $P = .049$ for Hospital Two, and $P = .009$ for Hospital Three. Kruskal - Wallis one way analysis of variance model was used to test for significance of association.

Satisfaction with Community Institutions and Hospital Acceptance

The literature on hospital acceptance shows that acceptance has been defined on both the attitudial and behavioral levels. Emperical indexes of acceptance have been use of hospitals, attitudes toward hospitals in general, and likes and dislikes of specific hospitals. Each of these indexes has certain weaknesses. It is felt, for example, that attitudes toward hospitals in general do not measure adequately the acceptance of a particular hospital because Americans tend to express the same attitudes toward hospitals in general that they express toward mother and county. The expression of likes and dislikes toward a particular hospital more nearly measures satisfaction with the hospital than acceptance of it, and use of hospitals ignores that segment of the society which does not have contact with the hospital, but upon whom the hospital must sometimes depend for support in the community. Acceptance has been conceptualized in this study as a number of general attitudes toward a particular hospital. Inasmuch as these attitudes range from thinking about the hospital as a part of the community to its actual support through use and contribution, it is felt that these attitudes will permit inferences to be drawn with respect to the integration of the hospital into the institutional structure of the community.

Tests were made to discern what relationship if any existed between the acceptance of the hospital as measured by scores on the hospital acceptance index and acceptance of other community institutions. There was no significant association between scores on the hospital acceptance index and the way the total sample and respondents in each hospital community felt about their schools, churches, and county officials. There was a significant association between feelings toward the doctors in the community and scores on the acceptance index for the total sample. As scores on the acceptance index increased so did the proportion of respondents who expressed satisfaction toward the doctors in the community. See Table 7. This relationship held for each of the hospital communities. However, the relationship was not as apparent in the county in which Hospital One was located as it was in the other counties. A much higher percentage of respondents in this community than in the other communities expressed dissatisfaction with their doctors. Although there was a tendency for those who expressed dissatisfaction with the doctors to also score low on the hospital

Table 5. Classification of respondents by number of organization memberships and scores on the hospital acceptance index.*

Number of Organization Memberships	Hospital Acceptance Scores		
	0 - 2 Percent N = 94	3 - 4 Percent N = 177	5 - 7 Percent N = 184
0	12	10	9
1	32	29	27
2	26	30	31
3	22	15	13
4	6	7	10
5 or more	2	9	9

*P = .02 as indicated by chi square.

Table 6. Classification of respondents by number of recommended health practices followed and scores on the hospital acceptance index.*

Number of Recommended Health Practices Followed	Hospital Acceptance Scores		
	0 - 2 Percent N = 94	3 - 4 Percent N = 177	5 - 7 Percent N = 183
0	7	9	7
1	22	19	18
2	26	27	21
3	26	22	27
4	19	24	27

*Not statistically significant.

acceptance index, many qualified their statement to indicate that the hospital was acceptable, but they would not want to use it because of the doctors on its staff.

Feeling toward the county health department and scores on the hospital acceptance index were also significantly associated for the total sample as well as for respondents in each hospital community. The relationship as predicted was positive. See Table 8.

Feeling toward the commercial establishments in the community and the community as a whole were also significantly associated with scores on the hospital acceptance index. In each case the relationship was positive. See Tables 9 and 10.

It may therefore be inferred that feelings toward the county hospital are related to the feelings held toward the other community institutions for a large proportion of the population. Some people hold the hospital in more esteem than they do such institutions as the schools and the churches. Criticism toward these institutions was directed toward specific cases, however, such as forced consolidation of schools resulting in excessive transportation time, and arguments in the church over various matters. As would be expected attitudes toward health related institutions, such as the County Health Department and physicians more nearly influence attitudes toward the hospital than do attitudes toward non-health related institutions. It will also be remembered that health consciousness was positively associated with attitudes toward the hospital. Although a cause

Table 7. Classification of respondents by feelings toward the doctors in the community and scores on the hospital acceptance index.*

Feelings Toward the Doctors in the Community	Hospital Acceptance Scores		
	0 - 2 Percent **N = 84	3 - 4 Percent N = 171	5 - 7 Percent N = 178
Satisfied	85	95	97
Dissatisfied	15	5	3

*P = .01 as indicated by chi square.

**Size of N varies for some tables because of no answers.

Table 8. Classification of respondents by feeling toward the County Health Department and scores on the hospital acceptance index.*

Feeling Toward County Health Department	Hospital Acceptance Scores		
	0 - 2 Percent N = 66	3 - 4 Percent N = 136	5 - 7 Percent N = 154
Satisfied	92	95	98
Dissatisfied	8	5	2

*P = .01 as indicated by chi square.

Table 9. Classification of respondents by feeling toward the commercial establishments in the community and scores on the hospital acceptannce index.*

Feeling Toward Commercial Establishments	Hospital Acceptance Scores		
	0 - 2 Percent N = 75	3 - 4 Percent N = 157	5 - 7 Percent N = 174
Satisfied	85	89	85
Dissatisfied	15	11	15

*P = .05 as indicated by chi square.

Table 10. Classification of respondents by feeling toward the community as a whole and scores on the hospital acceptance index.*

Feeling Toward Community as a Whole	Hospital Acceptance Scores		
	0 - 2 Percent N = 89	3 - 4 Percent N = 175	5 - 7 Percent N = 180
Satisfied	88	93	97
Dissatisfied	12	7	3

*P = .001 as indicated by chi square.

and effect relationship cannot be posited between health related factors and attitudes toward the hospital, it seems that a generally favorable complex of attitudes toward health and medicine in general is conducive to the growth and development of a strong county hospital. A following section will examine more closely the role of the physician in the formation of attitudes toward the hospital.

Contact with the Hospital

One basis for the formation of attitudes toward any object is experience with the object. However, many persons in rural Mississippi probably do not possess enough knowledge about hospital administration to make objective evaluation of the hospital when they come into contact with it. This is especially true when it is considered that until recently the conception of the hospital in the Southern rural subculture was a place where people go to die. Moreover the present study has shown that the expectations of the hospital as held by many persons in rural Mississippi vary considerably from those held by professional persons in health and medicine and the theories and practices of modern hospital administration. Nevertheless it was hypothesized that experience with the hospital would be associated with the attitudes held toward the hospital. A number of tests of the hypothesis were made for the general public.

Indirect Contact with Hospital: Persons were asked if they had made any visits to the hospital in connection with the hospitalization of a friend or a member of their family. It was thought that this would permit the visitor to make some evaluations of his own and to hear the complaints or compliments of the person whom they were visiting. Four hundred and fifty-one persons had made such visits, and those who had visited made significantly higher acceptance scores than those who had not visited. See Table 11.

A similar relationship existed between scores on the hospital acceptance index and indirect contact with the hospital in each of the hospital communities. However, the association between these variables was not significant for the county samples.

Direct Contact with Hospital: It cannot be determined, of course, if persons who have visited in the hospital made higher acceptance scores because they were favorable toward the hospital before their visit, because of observation made during their visit, or because they were influenced by what the persons whom they visited said. A classification of the sample according to those who had used the hospital themselves, or had members of their immediate family use it showed, however, that a significantly higher proportion of the total sample who had used the hospital themselves makes higher acceptance scores. See Table 12.

The association between direct contact with the hospital and scores on the acceptance index was also significant for persons in the counties in which Hospital Two and Hospital Three were located. The relationship between these variables was positive in all communities. However, the association was not significant for persons in the county in which Hospital One was located.

Satisfaction with the Hospital: Neither type of illness for which hospitalized nor type of room in which hospital stay was spent were significantly associated with scores on the hospital acceptance index. This was true for the total sample as well as for each

Table 11. Classification of respondents by indirect contact with hospital and scores on the hospital acceptance index.*

Indirect Contact with the Hospital Through Visits	Hospital Acceptance Scores 0 - 2 Percent N = 94	3 - 4 Percent N = 176	5 - 7 Percent N = 181
Had visited	86	94	97
Had not visited	14	6	3

*P = .01 as indicated by chi square.

Table 12. Classification of respondents by direct contact with the hospital and scores on the hospital acceptance index.*

Direct Contact With Hospital	Hospital Acceptance Scores 0 - 2 Percent N = 35	 3 - 4 Percent N = 106	 5 - 7 Percent N = 124
Respondent has been patient	46	62	66
Member of respondent's immediate family has been patient	54	38	34

*P = .01 as indicated by chi square.

individual sample. It was thought, however, that satisfaction with the services received while hospitalized would show a relationship to the general attitudes toward the hospital. Satisfaction was measured by a satisfaction index which consisted of the general reaction of former patients to eight aspects of the hospital's services.[9] These reactions were coded as favorable or unfavorable and scores of one and zero were assigned to each aspect on this basis. The items were subjected to item analysis. However, there was such a high degree of satisfaction expressed with each service that the items were not scalable. Hence, they were combined without regard for scalability.

There was a significant association between scores on the hospital acceptance index and scores on the index of hospital satisfaction for the total sample, and the relationship was positive. A larger proportion of persons with scores of from two to four on the index satisfaction made scores of 0-2 on the acceptance index. As scores on the acceptance index increased so did the proportion of persons making high scores on the index of satisfaction. See Table 13.

There was no significant association between scores on the acceptance index and scores on the index of satisfaction for each of the county samples. However, acceptance and satisfaction increased together in each of the counties.

Personal Influence

A number of studies have shown that personal influence and the mass media of communication play an important role in the acceptance of new ideas and techniques by various publics in the community. Thus, it was felt that these channels would also be important in the promotion of the hospital in the community. A number of personal influence and communication factors were therefore cross classified with scores on the hospital acceptance index in an effort to observe the relationship between these factors. Although only three of the personal influence items were significantly associated with scores on the acceptance index for the general public, it was apparent that these factors play a tremendous role in the hospital's total public relations program. The nature

Table 13. Classification of respondents by scores on the index of hospital satisfaction and scores on the hospital acceptance index.*

Scores on the Index of Hospital Satisfaction	Hospital Acceptance Scores 0 - 2 Percent N = 35	 3 - 4 Percent N = 106	 5 - 7 Percent N = 124
2	4	0	1
3	1	0	1
4	6	4	3
5	12	7	7
6	20	13	13
7	30	34	26
8	27	42	48

*P = .01 as indicated by chi square.

Although scores on the index of hospital satisfaction could range from zero to eight, no one made a score of less than two.

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[9] These were: (1) beds, bathrooms, general appearance, etc., (2) nurses, technicians and staff, (3) nursing services, (4) cleanliness, (5) food, (6) visiting hours, (7) rest and recuperative aspects, and (8) treatment from the business office.

of the role of personal influence varied considerably by hospital and was related to the total hospital-community environment of each. These differences will be considered for the most part in a subsequent section. However, relationships which have substantive importance will be considered before proceeding to the more subtle role of personal influence as a part of the hospital-community environment of each hospital.

Mass Media: There was no significant association between scores on the hospital acceptance index and reading about the hospital in the county paper, or attending a club meeting where the hospital was discussed as a part of the program for the total sample, or the individual samples when considered separately. A sizeable proportion of persons in the county where Hospital One was located and in the county where Hospital Three was located remembered reading about the hospital in the county paper. In both of these counties, however, the publicity was either unfavorable or involved both favorable and unfavorable aspects.[10] Hence, in both counties the publicity might have done as much harm as good. Fewer persons in Hospital Two's county remembered reading about the hospital in the county paper, but in general the relationship between these variables in this county was positive. This indicates, of course, that favorable publicity does have a generally favorable effect on the hospital if handled correctly.

Attendance at a club meeting where the hospital was discussed as a part of the program was closely related to scores on the acceptance index. However, the association was not significant, due primarily to the small number of respondents who had attended such meetings. The administrator had discussed the hospital with certain community and church groups, in the county where Hospital Two was located and in Hospital Three's county the home demonstration clubs had discussed the county hospital as a part of their general program in health. In both of these counties persons who had attended these meetings made higher acceptance scores than persons who had not attended the meetings. Thus, it appears that social participation may be used effectively by administrators to promote their hospital among the general public. Also in view of the tendency for formal participation to be class related, this medium would be instrumental in reaching the middle

Table 14. Classification of respondents by whether or not they had read about the hospital in thhe newspaper and scores on the hospital acceptance index.*

Read about Hospital in the Newspaper	Hospital Acceptance Scores		
	0 - 2 Percent N = 94	3 - 4 Percent N = 177	5 - 7 Percent N = 183
Had read about hospital	31	40	39
Had not read about hospital	69	60	61

*Not statistically significant.

Table 15. Classification of respondents by whether or not they had attended a club meeting where the hospital was discussed as a part of the program and scores on the hospital acceptance index.*

Attendance at a Club Meeting	Hospital Acceptance Scores		
	0 - 2 Percent N = 94	3 - 4 Percent N = 177	5 - 7 Percent N = 183
Had attended a meeting where hospital discussed	10	14	18
Had not attended a meeting where hospital discussed	90	86	82

*Not statistically significant.

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[10] In Hospital One's county this involved early administrative blunders which were politically inspired. The purpose of the publicity was aimed primarily toward the forced resignation of the first administrator. In Hospital Three's county the publicity involved a bond issue which was defeated twice before passage.

class upon whom support of the hospital must ultimately depend for much of its support.

Place of Residence: Place of residence in the county as determined by the beat in which the respondents were residing was significantly associated with scores on the hospital acceptance index for the total sample. However, these data mean nothing unless examined separately for each county. In all of the counties certain patterns were apparent. In Hospital One's community two beats on one side of the county contained a large proportion of the total county sample making low acceptance scores. This was explained in terms of the proximity of these beats to a regional medical center where a large proportion of families had always gone for medical and hospital service. The middle class families were thus oriented by tradition to this medical center outside of the county, and the lower class families held their identification because of the charity hospital located there.

Two beats in the county in which Hospital Two was located contained a large proportion of large land owners who showed little respect for their county hospital. In fact this was the only county in which there was a statistically significant difference between farmers who owned fewer than 100 acres of land and those who owned more than 100 acres on hospital acceptance scores. The large land owners were concentrated in two beats and were in general vocal with respect to their dislike for their county hospital.

Two beats in the county in which Hospital Three was located also contained a large proportion of persons with low acceptance scores. In this county neighborhood influentials appeared to be responsible for unfavorable gossip and discussion of the hospital, and the source of this unfavorable publicity appeared to be politically inspired.

Formal and Informal Discussion about the Hospital: The literature on hospital-community relations has shown that persons who are connected with the hospital, such as the professional and sub-professional staff, and the family physician may have an influence on the attitudes which persons with whom they associate have toward the hospital. A number of items designed to measure this type of influence were considered. However, only two were significantly associated with scores on the acceptance index. These were having discussed the hospital with the family doctor and having a friend connected with the hospital. Almost 70 percent of the respondents with scores of 0-2 on the acceptance index did not know anyone connected with the hospital. This compared to 30 percent of respondents with scores of 5-7. Also those who had a good friend employed by the hospital made higher scores than those who did not have this connection. See Table 16.

A similar relationship was observed in each of the hospital communities. When asked how the person connected with the hospital whom they knew felt about the hospital, respondents generally said they praised it, or they have done much to make me appreciate it. However some respondents would not commit themselves. It, therefore, appears that employees of the hospital may be instrumental in promoting the hospital among the general public; of course, if employees are

Table 16. Classification of respondents who had a friend connected with the hospital by scores on the hospital acceptance index.*

Knows someone connected with the Hospital	Hospital Acceptance Scores		
	0 - 2 Percent N = 93	3 - 4 Percent N = 177	5 - 7 Percent N = 181
Does not know anyone	61	38	29
Has a good friend employed there	13	25	30
Has a friend employed there	11	20	23
Only speaks to someone employed there	15	16	17

*P = .001 as indicated by chi square.

Table 17. Classification of respondents who had discussed the hospital with their family doctor by scores on the hospital acceptance index.

Discussed hospital with family doctor	Hospital Acceptance Scores		
	0 - 2 Percent N = 93	3 - 4 Percent N = 175	5 - 7 Percent N = 446
Discussed with doctor	14	19	25
Did not discuss with doctor	86	81	75

critical of the hospital they may also retard its acceptance.

A small proportion of respondents said that they had discussed the hospital with their family doctor. As the scores on the hospital accepance index increased, however, the proportion of persons who had discussed the hospital with their family doctor also increased. See Table 17. Similar patterns were observed for each of the counties. When asked how their own family doctor felt about the hospital most respondents said their doctor liked it. Only in the county in which Hospital One was located and in the county in which Hospital Two was located did respondents say that their doctor was unfavorable toward the hospital. These were patients of one doctor in each community and interviews with the doctors and the hospital administrator indicated some hospitality on the part of these doctors toward the hospitals. Hospital Three at one time also had a doctor who was hostile toward the county hospital. Although this doctor no longer practices medicine in the community some of his former patients held rather negative attitudes toward the hospital at the time of the interview. However, many respondents said that they had changed their opinion of the hospital since Dr. X left the community.

One could draw tentative conclusions on the basis of the data above on the relationship between objective factors and hospital acceptance. However, certain non-objective factors were important in explaining the relationship between the general public as well as each of the specific publics. A following section will consider these non-objective factors.

THE UNIQUE HOSPITAL SITUATION

In each of the communities studied there were a number of "non-objective" factors which influenced the status of the hospital in the community. Some of these were alluded to in the previous section where attitudes toward each hospital were examined. In this section the unique situation of each hospital, together with factors which bear, either directly or indirectly, on the status of the hospital in the community will be considered.

Hospital One

This hospital opened in 1951 with a 26-bed capacity. However, an expansion program was later effected, and its capacity was increased to 47 beds. In spite of its recent construction the interior of the hospital does not give the appearance of a well kept institution. This results in part from poor construction and perhaps in part from poor housekeeping. Also many persons in the county are concerned over the lack of separate facilities for Negroes and whites in the hospital. The big concern in this respect is over the integrated nursery which has been criticized on several occasions in the press. However, the factors retarding acceptance of the hospital fall largely within three categories, namely: (1) tradition, (2) lack of confidence in the hospital and its medical staff, and (3) the political climate in which the hospital must operate. These factors contribute to the general climate of opinion toward the hospital and each needs to be examined rather closely.

Traditionally persons in this county have gone outside of the county for hospitilization and for medical services which require more than routine treatment. This is true because there was not a hospital in the county prior to 1951, and as mentioned earlier because of the proximity of the county to two regional medical centers. Thus, many persons in Hospital One's service area have strong attachments to hospitals in the regional medical center outside of the county, and a high percentage of these persons named a physician in these centers as their family doctor. This was more true for the side of the county which is nearest to the regional center than for the county as a whole. However, it appears that a substantial number of the higher status persons will continue to use out-of-county facilities for other than routine services. Nevertheless, many of these favor having a hospital in the county, and they said they would support the hospital through means other than use.

Closely associated with the use of out-of-county hospitals is Hospital One's policy with respect to charity. The administrator and medical staff of the hospital stated that there is no real need for the hospital to render charity care because all persons in the county are financially able to pay for services. The board of trustees and other political groups concurred. However, this is a poor county and many persons have gone to the nearby medical center for charity services. It was reported that at least one death occurred between Hospital One and an institution where charity care was available when the hospital refused to admit an alleged dying patient because the person could not pay for services. Other stories with the same implications were told to the research team. Actually some of the stories were at least in part true; some were exaggerated. However, many persons in the county felt that the hospital's policy with respect to charity should be re-examined. It appeared to the research team that the policy with respect to charity was based more on sound fiscal policy than on the basis that no need for charity care was apparent. Since a state charity hospital was near it was more expedient financially for both the hospital and its medical staff to insist that charity patients use the charity hospital. On the other hand, it appeared that neither the administrator nor the medical staff were willing to admit to the public that this was the reason they did not serve the element of the county's population which needed charity care.

The second factor which has been detrimental to Hospital One's position in the community is the distrust which many persons said they had of the hospital and of its medical and nursing staff. Many persons criticized the hospital for its lack of registered nurses and an incompetent nursing staff in general. Many of these persons, of course, were not able to objectively judge the competency of the nursing staff. Nevertheless, a general lack of trust of the nursing staff was expressed among persons throughout the county.

A lack of confidence in the medical staff was also expressed by a large number of persons in the community. The physicians in this county are young and are just beginning their practice. The one exception is an older doctor who has not joined the staff of the hospital but continues the practice of referring patients who need hospitilization to physicians in one of the nearby regional medical centers. Because of their recent connection with medical schools and larger hospitals, the younger physicians probably possess knowledge with respect to the newer developments in medicine which an overworked older doctor might not possess. However, a large percentage of the general public fails to understand this, and these persons indicated that they will continue to use doctors outside of the county for serious illnesses.

The third factor which retards the integration of the hospital into the institutional structure of the community is the unfavorable political climate surrounding the hospital. The second and present administrator is well liked by county residents. However, many persons feel that the hospital has been a political football in the past, and there is much resentment of this. The members of the board of trustees do not appear to possess much knowledge with respect to hospital administration. Interviews with the trustees showed, however, that they consider themselves to be charged with administering the hospital. They reserve for themselves a major role in all policies of the hospital and appear to want to reserve administrative prerogatives which rightly belong to a professional administrator. The present administrator appears to have minimized the potential conflict in his position. However, the emphasis which he must place on maintaining good relationship with the board of trustees makes it almost impossible for him to devote the time needed to promotion of the hospital among other groups. Hospital business keeps him out of virtually all community organizations and activities. His only membership in a community organization is the church. He is aware that some women want to organize an auxiliary but he has not capitalized on their enthusiasm. Neither would he reveal their names to the research team.

The relationships of this hospital and its administrator with the present political groups, the board of trustees, and the medical and nursing staff appear to be fairly good. However, the hospital needs to be vigorously promoted among the larger general public in the county. This would entail the utilization of present channels of communication to explain operation of the hospital to the general public. Also the administrator should cultivate additional communicative channels through an auxiliary or existing groups concerned with welfare in the community. Finally, the administrator should devise some means whereby the board of trustees might acquire more knowledge with respect to hospital administration, without reserving for themselves control of the hospital. This problem is wide spread and to correct it will either require legislation or a large scale program of education and indoctrination. It should, therefore, be studied further with the view of divising appropriate steps to correct it.

Hospital Two

This hospital was like Hospital One in that it was the only hospital in the county. However, a large number of persons did indicate that they would seek hospital service outside of the county should the need arise for such services. This was largely due to the hospital's alleged policy with respect to charity, and the persons who would use out of county hospitals because of this were of two types. Older persons in the hill section of the county said they would go to a nearby private hospital if hospitalized because they could get charity care there. Also the more prosperous farmers in the Delta side of the county said they could not get charity care for their tenants at Hospital Two and they did not like the hospital nor its administrator for that reason. However, very few persons said they would go outside of the county for hospitalization because of poor services rendered by Hospital Two or because of attachments to hospitals and physicians outside of the county.

It was the feeling of the research team that county residents misunderstood the policy of Hospital Two with respect to charity. The administrator admits that he has resisted excessive demands for charity care by the prosperous residents who are able to pay for services. However, he claims that persons who actually need charity care are not denied. A check on the number of persons who had received charity care lead the research team to believe that a cautious but community service oriented policy with respect to charity was followed. This in part explains why the hospital's rate of occupancy is higher than the average of all hospitals in the state, yet this one operates on a self supporting basis.

The degree of success of Hospital Two may largely be attributed to its administrator. His background in administration and his manipulation of political factors have placed him firmly in control of the hospital's destiny. The board of trustees of the hospital and the board of county supervisors have acquired a cusory knowledge of hospital administration as a result of a conserted effort to inform them. These groups therefore appreciate the administrator's position, and policies which they must approve are generally accepted on his recommendation.

Hospital Two does not have an auxiliary. The administrator feels that this group would serve a useful purpose, but that they might start rumors and gossip about the hospital which in the long run would cancel out the good which this group might do. The administrator has therefore asked church groups, civic clubs and other organizations interested in social welfare to provide certain facilities and services. As a result many groups throughout the county have become involved in the hospital's program. However, there is one community in the edge of the county from which the hospital derives little support. Several ladies in this community are active in the auxiliary of a hospital in a nearby town. These ladies in turn have done much to support the outside hospital at the expense of Hospital Two.

The relationships between the administrator of Hospital Two and its medical and nursing staff were generally good. However, this community has one physician who has practiced in the community for a long time and is held in high esteem by a sizeable proportion of the population. This physician has criticized the hospital and its administrator to some patients. Many of this physician's patients made low scores on the hospital acceptance index and they volunteered remarks which Dr. X had made to account for their negative attitudes toward the hospital.

As a whole, the relationships of Hospital Two with each of its publics were superior to the relationships of the other hospitals and their publics. The criticism of Dr. X, a misunderstanding of policies with respect to charity, and the influence of ladies who serve in the auxiliary of another hospital largely explain any weak spots in Hospital Two's public relations program.

Hospital Three

Factors which were related to Hospital Three's status in the community may generally be subsumed under two broad categories: (1) a competitive hospital situation and (2) administrative blunders made by the first administrator during the early operation of the hospital.

This hospital was located in a county which also contained a small proprietory hospital and a limited service clinic. The limited service clinic was located in one side of the county and was staffed by an energetic young physician who was held in high esteem by many persons in the service area of the clinic. This clinic accepted only minor cases involving hospital confinement and was designed as a feeder unit to Hospital Three. However, most of the referrals from this clinic to larger general hospitals were made to a hospital outside of the county rather than to Hospital Three. This was due in part to the fact that persons in this community had traditionally gone to the out-of-county hospital for services involving more than routine treatment, and in part to a reluctance of Hospital Three's administrator and medical staff to cultivate a warm professional relationship with the physician on the staff of the limited service clinic.

The proprietary hospital in the county where Hospital Three was located actually received more support from the residents of the county than did Hospital Three. This hospital had operated as the only hospital in the county for several years prior to the construction of the county hospital; it was staffed by two of the six general practitioners and one of the two surgeons in the community. The general practitioners were well established in the community and they were revered by a large clientele. Therefore, the refusal of these physicians to use Hospital Three resulted in a large percentage of the county population refusing to use it also.

A comparison of Hospital Three with the proprietary hospital in its community revealed some rather striking differences between the two institutions. Hospital Three was accredited by the American Hospital Association. Its plant was modern in every respect, and the hospital maintained a "hospital atmosphere". The proprietary hospital, on the other hand, was not accredited and had an atmosphere of a large doctor's office where patients came to be near their physician until they got well. There were no visiting hours and it is alleged that the nursing staff treated patients as if they were helpless to satisfy any need during their sickness. Many former patients of the proprietary hospital said that being able to go to this hospital was one incentive to get sick. Persons who used the proprietary hospital may be placed in two groups, with respect to their attitudes toward Hospital Three: (1) those who thought it was a terrible place and could give no reason why they felt this way, and (2) those who were more or less indifferent toward it, i.e., thought it was a nice hospital and were willing to give it support in every way except use. It is believed that the first group felt the way they did because of their loyalty to their physician at the proprietary hospital and because they liked the proprietary hospital itself. These people would not want to go to any other hospital and would be unhappy if their doctor said they should use Hospital Three. The second group felt loyalties to their doctor only and would probably be happy if he used Hospital Three or a more modern hospital.

An examination of the objective characteristics of each group showed that they did not differ significantly with respect to age, income, education, and other factors of this general order. However, there were members of both groups who cited examples of administrative blunders, malpractice, politics and the mercenary character of Hospital Three to rationalize or reinforce their attitudes toward it. Some of the examples cited had no basis in fact, but they were, of course, real to the persons who cited them.

The present administrator of Hospital Three felt that one of the biggest obstacles to the acceptance of this hospital by the public was the large number of rumors circulated about the hospital. Many people thought, for example, that Hospital Three's prices were out of line with the proprietary hospital. A check on prices showed the prices to be similar. There was also a belief that Hospital Three refused charity patients and that the proprietary hospital did all the charity work. Actually there was little difference between the two hospitals with respect to their policy on charity. This belief arose when the administrator of Hospital Three, in an attempt to correct the belief on the part of many county residents that Hospital Three was a charity hospital, required a deposit when patients were admitted. The administrator soon abandoned this practice but the damage which was more or less permanent, had been done. Also many people in the county said that the present administration of Hospital Three was cold and unfriendly and that he and the hospital were run by a controversial member of the board of trustees. It was not determined whether or not this was true, but the tenure of this controversial person on the board of trustees did much to hurt the hospital among some groups in the county.

At the time of the survey all doctors in the county seat were complimentary toward the hospital, and this proved to be related to the attitudes which persons in the community held toward the hospitals. However, in the past several physicians had done much to create unfavorable impressions of the hospital among their patients. This also has had a lasting effect. There were two physicians in the outlying villages in the county who did not use either Hospital Three or the proprietary hospital, but used hospitals in adjoining counties. Although these areas were outside the service area of Hospital Three, this nevertheless had its effect on the hospital, as the county is considered the hospital service area politically and these villages could not be counted on to support the hospital in such matters as expansion, and increased tax support.

There was some disagreement also between the auxiliary and the administrator of Hospital Three. Several auxiliary members criticized the administrator as being lazy and of destroying the good will which the auxiliary created. In the earlier phases of this study it was hypothesized that the auxiliary is an important means of promoting the hospital in the community. This belief is still held. However, in comparing Hospital Three with Hospital Two some reservation must be made in this respect. If the administrator cannot work harmonously with an auxiliary certain advantages may accrue from working with other groups interested in welfare but less involved in the operation of the hospital.

SUMMARY AND IMPLICATIONS

Summary

This study was conducted in an effort to determine acceptance of hospitals by persons for whom they have been built, and to arrive at criteria which hospital administrators can use for establishing a program of favorable relations between the hospital, its several publics and the community at large. The study was conducted over a period of five years and included a study of all hospitals and hospital administrators in Mississippi. A final phase of the study consisted of case studies of three hospitals to determine their acceptance by the community and to observe factors which would help explain the relative success of each hospital.

The earlier phase of the study showed that hospitals in Mississippi which have good relations with their publics are new, publicly owned units, which were founded by community leaders, and which do a lot of charity work. This phase also showed that the administrator largely controls the fate of his hospital. Hospitals which have good relations with their publics are administered by persons who also score high in public relations. Hospital administrators with good public relations are trained in administration, and identify professionally with hospital administration only. They make better salaries than administrators with poor public relations; they do not change jobs often; and they participate widely in professional and community organizations.

The case studies were conducted in hospital communities which contained relatively new Hill-Burton hospitals with 50 or fewer beds. These studies identified publics of the hospitals and observed the acceptance of the hospitals by each of the publics. Acceptance by the general public was conceptualized as consisting of a number of general attitudes toward a specific hospital. This definition of acceptance was felt to be superior to existing definitions. The previously used definitions of acceptance are use of the hospital, attitudes toward hospitals in general and likes and dislikes of specific hospitals. The universe of attitudes toward the hospitals studied included variations of the above definitions of acceptance. However, it is believed that some weaknesses of the above definitions were overcome with a combined index of seven internally consistent attitudes toward the specific hospitals. The attitudes ranged from thinking about the hospital as a part of the community to its support through use and contributions. It was felt that this index would permit inferences to be drawn with respect to the integration of the hospital into the community.

These attitudes were observed for 150 white housewives in each of the hospital communities. Each person received a hospital acceptance score of from zero to seven, depending upon the number of attitudes of acceptance expressed. A classification of respondents by hospital acceptance scores showed that the hospitals enjoyed rather wide, though not complete, acceptance. Hospital Two which was located in a part hill, part Delta county in northwest Mississippi enjoyed the greatest relative degree of acceptance as indicated by scores which members of the general public made on the hospital acceptance index and by the relations of the hospital and its administrator with the other publics.

Objective factors which are related to the acceptance scores of the general publics were personal and class related factors, contact with the hospital, and personal influence factors. Non-objective factors which made up the general environment of the hospital were also related to the acceptance of the hospitals by each of the publics and helped to explain variations in the acceptance scores of the general public for each of the hospitals studied. Thus, it is necessary to consider the non-objective factors in order to interpret the role of the objective factors in acceptance.

There was a curvilinear relationship between hospital acceptance and class related factors for Hospital One, an inverse relationship between these variables for Hospital Two, and a positive relationship for Hospital Three. Hospital One was not accepted by the upper and lower class elements of its community according to the definition of acceptance and class used in this study. Apparent reasons for this were: (1) this hospital accepts no charity cases and the lower class persons must use a nearby state charity hospital; (2) upper class persons go to nearby medical centers for hospitalization and medical services because of tradition; and (3) there is a general lack of confidence in Hospital One's medical and nursing staff as well as disssatisfaction with its physical plant.

Hospital Two was not accepted by the more prosperous farmers in its county. This group resented the fact that the hospital would not accept their croppers and laborers as charity patients without questioning the obligation of their employers to pay for services. Acceptance of Hospital Three increased consistently as one's social class position increased.

Attitudes toward other community institutions were related to the way persons felt about their hospitals. However, attitudes toward other health related institutions were more important in this respect than attitudes toward non-health related community institutions. Persons who were generally satisfied with the community's County Health Department, and the physicians in the community, and those who had adopted the largest number of recommended health practices were most favorable toward their county hospital.

Contact with the hospital was related to its acceptance in all counties. Persons who had visited or used the hospitals were much more favorable toward them than persons who had not used them. Also persons who had used the hospitals were highly satisfied with the services offered.

Personal influence was related to the acceptance of all hospitals. Persons who knew someone connected with the hospitals were more favorable toward them than persons who did not have this vicarious connection. Also the comments of hospital employees and physicians in the community did much to influence acceptance of the hospital. A physician in the county in which Hospital Two was located and in the community in which Hospital Three was located had openly criticized the hospital or its administrator and many patients of these physicians were unfavorable toward the hospitals. Also in one community several neighborhoods were identified where most persons were unfavorable toward the hospital, and the reason for this could be traced to neighborhood influentials who were vocal against the hospital. Resentment of these influentials could generally be explained by personal or political reasons, such as dislike of a member of the board of trustees or of the hospital administrator. Closely associated with each of the above were the rumors and gossip about the hospitals. These ranged from the deaths which had occurred in Hospital One's community because of the hospital's refusal to admit dying patients who could not pay for services to the prevelance of staphylococcus disease in Hospital Three. Many of these rumors were unfounded, and their source could not be detected.

The mass media of communication were also influential in molding opinions toward the hospital. In the counties where Hospital One and Hospital Three are located, however, the press may have done more harm than good. Moreover, discussion of the hospital at club meetings and other public gatherings proved to be a favorable means of promoting the hospital in counties where this medium had been used to carry the hospital's story to the public.

Implications

The findings of this study have certain implications for the hospital service industry. Also since the acceptance of a hospital by a community is in the main a "human related" problem the findings have implications for sociology in general. One purpose of the study was to arrive at criteria of effective relationships between the hospital and its various publics. Inasmuch as the larger general public is the ultimate group with whom acceptance of the hospital lies the first concern will be with criteria of effectiveness with this group.

The General Public

One index of acceptance among the general public is use of hospital. Many administrators who have no apparent competition tend to assume that their hospital has a monopoly on the hospital business in their community. This study has shown this not to be the case. If persons do not like a hospital they will drive a long distance to use one they do like. There may be several reasons why persons do not like a hospital. Some of these reasons may be inherent in the hospital itself, such as size of the hospital, distrust of the hospital and its medical staff, lack of equipment and personnel to handle certain types of cases adequately, and poor treatment of patients and their family by the nursing staff and the business office. Other reasons may be external to the hospital, such as traditional use of physicians and hospitals in other communities, dislike for the hospital and/or its administrator for various reasons, failure of the hospital to render charity care, or strained relationships betwen the hospital and large segments of the population. The effective administrator should be able to recognize groups who do not use his hospital, to determine why, and to formulate means whereby these conditions may be corrected.

If use of a hospital were the only index of acceptance those persons who do not use the institution by definition would not accept it. However, this study has shown that persons who do not use a hospital may be favorable toward it and willing to support it in every way except use. Thus, another index of acceptance is opinion which persons in the hospital's service area have of the hospital. For the general public this includes both general and specific attitudes toward the particular hospital. For persons who use the hospital it includes likes and dislikes of the hospital, or satisfaction with the way the hospital is performing its task. This type of information is not always easy for the administrator of a hospital to acquire. However, the administrator might work through schools, churches, or other existing groups to get questionnaires completed wherein attitudes of the general public toward the hospital would be tapped. Also patients and members of their families might be asked to complete questionnaires which would furnish information with respect to likes and dislikes of the hospital. The findings from this study also lead one to believe that this would serve as an excellent public relations device for the hospital. It would get people to thinking about the hospital and perhaps make them feel that the hospital is concerned with their feelings toward the way it is performing its role.

'Another index of acceptance among the general public is the amount and type of gossip and rumors which one hears in the community about the hospital. Some administrators have said that this was the biggest obstacle which their hospitals had to overcome in winning acceptance among the general public. These rumors may arise out of dissatisfaction with the way the hospital is performing its services or they may result from dissatisfaction with other aspects of the hospital.

The source of rumors is frequently hard to determine, and the administrator may never know of the rumors himself. However, each administrator should employ methods to project a favorable image of his hospital to the public. This may be done through the local press, speeches to civic clubs or other community organizations, and the personal influence of employees and other persons connected with the hospital.

In the field studies it was found that persons who remembered reading articles about the hospital in the county paper expressed more favorable attitudes toward the hospital than persons who could not remember reading about the hospital. Also persons who had attended a club meeting where the hospital was discussed as a part of the program expressed significantly more favorable attitudes toward the hospital than persons who had not attended such a meeting.

Former patients are also important means of projecting a favorable image of the hospital to the community. One satisfied customer is perhaps worth a million words. Therefore, the hospital should strive to satisfy the patient's needs insofar as possible. In many cases this will include the satisfaction of basic emotional and psychological needs in addition to routine nursing care, food, cleanliness and diagnosis. In one community persons were asked why they continued to use an obsolete proprietary hospital when by their own admission the county hospital had better equipment, a nicer plant, and offered more sophisticated services. The answers revealed that the persons not only had their physical needs satisfied when they went to this hospital, but the atmosphere was such that emotional and psychological need of patients would usually be satisfied also.

This study has revealed that rural residents in Mississippi expect some degree of informality and "folkness" from the hospital, and when the rural hospital becomes too sophisticated patients and their families begin to complain. This desire for folkness is part of the expectation complex which potential patients have of the hospital. It is not too surprising in view of the fact that until recently all but major illnesses were handled in the home in the southern rural sub-culture, and that the hospital was perceived by many as a place to go to die. The degree to which the hospital fulfills the expectations of its patients is associated with the degree of acceptance and satisfaction of the hospital. Talks with patients and their famiiles may give the administrator some indication of the expectations of his hospital. The efficient administrator must then decide how to adjust performance to expectation, or vice versa.

A final index of acceptance among the general public is the amount of support which residents of the hospital's service area give the hospital in comparison to support given other institutions. In the case of Hill-Burton hospitals this includes tax support as well as use and contributions. Willingness to support the hospital through one means may not mean willingness to give whole hearted support. In one county for example residents of one neighborhood remarked that they liked the hospital and would use it, but that they would not support any move to add to the plant or equipment of the hospital as long as Mr. X remained on the board of trustees. It was a common tendency for persons to indicate willingness to support the hospital in every way except through increased taxes. The reason for this is in most cases a misunderstanding of the obligation of tax support to maintain the hospital or to improve its plant and services. In many cases this condition could be overcome with a good public information program. The administrator needs to know what conditions stand in the way of a willingness to assume financial support before he can try to overcome them. Working through neighborhood influentials is one good way to get this information.

It is not common for Hill-Burton hospitals to ask for support in the form of contributions. However, several hospitals have asked for contributions from persons and groups in their service area. One involved the churches and other community groups in a fund raising campaign to build and equip a small chapel in the hospital, and to provide other services which lay outside of the area of hospital care. Also in one case the auxiliary asked persons for surplus produce from home gardens to be used in the hospital kitchen. In both cases the involvement of persons and groups in this type of support of the hospital served as a public relations device. Anytime persons and groups are made aware of the needs of the hospital and respond favorably, the administrator can be assured that he has elicited a stronger commitment of support in the long run.

The Board of Trustees

Outside of the general public probably no group is more important to the success of the Hill-Burton hospital than the board of trustees and the board of county supervisors. Administrators frequently judge their effectiveness with these groups by their support in financial matters, and in making and implementing policy. However, it should be remembered that these groups are closest to the general public, and they can have a tremendous influence on the success of the administrator and the hospital among the general public.

Perhaps one of the biggest problems of the new county hospitals is a clear definition of the role of the trustee in the operation of the instiution. In many communities the county hospital is perceived by the board of trustees, the board of county supervisors, and a large proportion of the general public as being a sort of Jeffersonian bureaucracy. Thus, in these counties the board of trustees may want to assume more power in the daily operation of the hospital than is rightly theirs. In one county, for example, all members of the board of trustees were particularly happy with the administrator because, as they expressed it, "he more or less let them run the hospital."

In most cases members of the board of trustees are uninformed on all aspects of hospital administration. Therefore, if they are to have more than a nominal role, some means must be taken to inform this group of the many facets of hospital administration. This would include information with respect to the role of the hospital as a business organization as well as a community service organization. It is the belief of the research team that one of the most urgent needs of the new county hospitals is some standard procedure to recruit board members, to indoctrinate them once they are chosen, and to provide for some sort of continuing education once the program is begun.

The Medical Staff

The physician is one of the key persons in the promotion of the hospital. This study has shown that a large percentage of persons will choose a particular hospital because their doctor uses it. Thus, when there is a choice of hospitals in a community the decision is made on the basis of the hospital which the family physician uses. Also families who must use a hospital outside the community generally follow the recommendation of their family physicians on where to go, what specialists to consult, and what hospital to use.

There is evidence that persons place more confidence in their physician than they do in the hospital. Thus, even mild criticism of the hospital by a physician in the presence of patients may create an unfavorable impression of the hospital in the eyes of the patient. The data showed that this was true for both Hospitals Two and Three. Also the physicians can be beneficial to the hospital in explaining policies with respect to charity. In the county in which Hospital One was located neither the hospital nor the physicians were willing to assume their share of the responsibiilty for the hospital's policy on charity. However, the policy was financially expedient for both parties. There is also evidence that patients do not know whom to blame for minor dissatisfaction with respect to service and diagnosis, and such things as visiting hours and other regulations. It is easy for the hospital as well as the doctor to shift the blame to the other unless a satisfactory arrangement for handling complaints is worked out.

It is therefore encumbent upon the administrator to maintain favorable relationships with his medical staff. The personality of the physician and of the administrator may bear upon this problem. However, administrators must be able to identify potential areas of conflict between the medical staff and the hospital. Policies must be established jointly by the medical staff and the administrator if they are to be satisfactory to both parties. Also communication between the two levels must flow freely so that conflict is made apparent and can be resolved, and each party must be willing to assume its obligations as well as rights. All persons involved in medical and hospital care have a stake in the hospital. Therefore, a regular review of its status together with a consideration of internal and external problems is of importance to all concerned.

Local Community Leaders

Any program designed to create a major change in the status of the hospital in the community will require a long period of time. It will also need the support of community leaders who exert their influence through informal channels as well as those who are easily identified as community leaders by virtue of their positions in formal community organizations. Obviously to secure the support of the community power structure one must be able to identify persons who have influence. This may be no easy task in view of the fact that the persons with the most power may not hold any formal positions of influence in the community. However, the effective adminstrator will be concerned with the identity of power holders and will discern the most effective way to work through the existing structure.

Failure to win support of community influentials has spelled defeat for expansion programs of some hospitals as well as programs of a more general nature involved in the day to day operations. Also it will be remembered that neighborhood influentials in part accounted for the negative attitudes which persons in several neighborhoods held toward Hospital Three. There is no magic formula for working with the community power group. However, administrators should be cognizant of its importance and use it when possible for the hospital's advantage.

Persons and Groups Interested in Community Welfare

There are many persons and groups in every community who are interested in welfare. These groups may have governmental connection such as the county health and welfare departments, or they may be local groups, such as churches and civic clubs, which have welfare programs as a part of their overall program. Each of these is either directly or indirectly a partner of the hospital in providing services which are essential to the welfare of the community. Also many of these groups serve as the connecting link between the hospital and a large segment of the general public.

As a community service institution Hill-Burton hospitals have an obligation to render some charity care. Close cooperation between the hospital and such groups as the county health and welfare departments can be beneficial to all groups concerned in the handling of charity cases. The health and welfare departments frequently wish to recommend persons to the hospital or to a medical doctor for charity care. On the other hand, the cautious administrator may sometimes desire the help of the welfare department or other groups in establishing eligibility of some charity patients.

Certainly all groups concerned with welfare can be of benefit to the hospital in formulating and publicizing policy with respect to charity. This is another of the major needs of Mississippi hospitals. Many persons have the notion that all Hill-Burton hospitals are charity hospitals. Thus, some people who are able to pay expect free services. Some administrators have attempted to solve this problem by refusing charity patients. However, this policy appears to be more determental than beneficial to the hospital. Administrators, therefore should cultivate channels of communication through existing groups interested in welfare to inform the general public of the hospital's need to be self supporting as well as its desire to serve all elements of the population.

Other persons and groups interested in welfare may be beneficial to the hospital if handled properly. One such group is the ladies in the community who are interested in the hospital auxiliary. These ladies are generally higher status persons who desire some channel through which they can render a welfare service to the community. Thus, they have resources in the form of time, talent, and sometimes money which the hospital can use to an advantage. Also these women are usually members of or close to the existing power structure of the community and they can exert influence at this level to the benefit of the hospital. However, only the administrator who has a clearly defined and useful program for the auxiliary should attempt to have one. If the auxiliary members spend a small portion of their time criticizing the hospital or its administrator they may do more harm than good.

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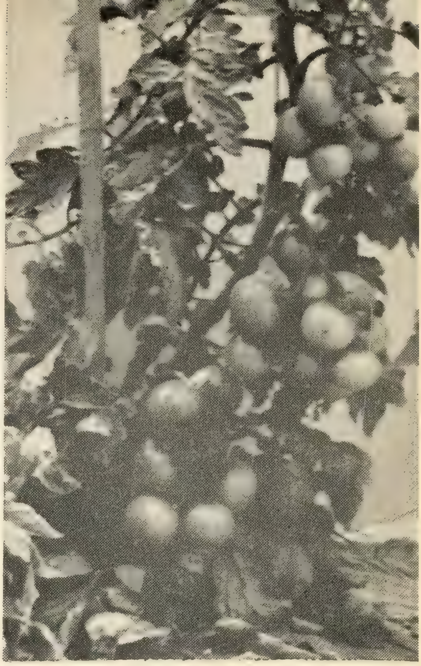
Heating Plastic Greenhouses



This photograph (Figure 5) demonstrates the excellent plant growth and fruit set obtained in a plastic greenhouse equipped with a forced warm-air furnace located in the heating and air movement quarters.

By E. L. MOORE and T. N. JONES

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HEATING PLASTIC GREENHOUSES

By E. L. MOORE and T. N. JONES[1]

Successful production of vine ripened greenhouse tomatoes depends upon several factors, one of which is a satisfactory heating system. A satisfactory system should maintain the desired temperature, distribute it evenly over the plant growing area and not pollute the atmosphere in the house.

The desired temperatures for growing tomatoes are 60 to 66 degrees Fahrenheit at night and on cloudy days, with 70 to 80 degrees when the sun is shining. Night temperatures either below 58 or above 68° F. cause tomato flowers to drop. Temperatures above 80° F. at the time of fruit maturity induce cracking and bursting of tomatoes.

Normal atmosphere is composed of about:

78 percent nitrogen
21 percent oxygen
.03 percent carbon dioxide
small amounts of other gases

Natural gases used as fuel contain materials such as methane and ethane, which injure tomato plants. These injurious materials are composed of unsaturated hydrocarbons (2). Symptoms of gas injury are folding of the leaflets, curving of the leaves, yellowing of the flower stalks, dwarfing of the flowers and flower abscission.

When gas burns in the confines of a combustion chamber, extremely high temperatures are reached. Dehydrogenation occurs, resulting in more unsaturated hydrocarbons. Water, carbon dioxide and unsaturated hydrocarbons, such as ethylene, butylene, propylene, and carbon monoxide are given off.

Carbon dioxide is beneficial to plants as it is used in the processes of growth. Research reports agree that increasing the carbon dioxide content of the atmosphere is more often beneficial than harmful. Livingston and Franch (3) increased carbon dioxide to 20 percent for several hours and noted no harmful effects on several kinds of plants. Thomas and Gill (6) exposed tomatoes to 3 percent carbon dioxide for several days and observed ill effects after ten days. This was 100 times normal and much higher than may be reached in a greenhouse even during several hours.

The other gaseous materials cause various degrees of damage. For instance, only 0.1 part per million of ethylene in the atmosphere for 48 hours caused tomato leaves to bend and curl (1). Butylene, propylene and carbon monoxide induce similar effects, although higher concentrations are required to bring about abnormal growth. In relation to ethylene it requires 500 times as much propylene, 5000 times as much carbon monoxide and 500,000 times as much butylene to cause the equivalent ill effects. Resulting abnormalities resemble those induced by sprays of 2,4-D. It is, therefore, essential that these fumes are completely exhausted from the house.

A recent survey (4) indicates that gas fired warm air furnaces are the most commonly used system for heating plastic greenhouses. The warm air furnaces in use are equally divided into two general types. One is a convected heat system; the other is a forced warm-air system. With the convected type, air is forced into a combustion chamber, heated, pulled or pushed through metal ducts and eventually exhausted from the house. Heat from the hot air radiates through the pipes, setting up convection currents, which distribute the warm air over the house. Most of the fumes from the combustion chamber are expelled from the house through exhaust ducts.

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There are three types of convected heating systems. In one the air and products of combustion are forced through the ducts by natural air flow. The second is equipped with a motor-driven fan located near the heater that pushes the air and products of combustion through the ducts. The third is equipped with a motor driven fan located near the exhaust end of the ducts that pulls air and the products of combustion through the ducts.

There are disadvantages to these convected air heating systems. First, heat distribution over the house depends entirely on convected air currents. Air movement is slow. With limited air movement temperature strata form. The hot air lingers near the ceiling and the cold air near the ground level. Second, it is virtually impractical to eliminate all the leaks at the joints and seams of the ducts. Third, the fan runs only when the heat is on. Without air movement in the duct system fumes from the pilot light collect in the combustion chamber and seep into the plant growing area.

Of the three convected air heating systems the one with the fan located near the exhaust end of the duct has proven best for eliminating gas fumes in our tests. The fan continually running formed a vacuum in the ducts and retained the fumes until they were exhausted. In contrast, when the fan was located near the heater, a pressure was formed in the duct system and fumes were expelled through leaky joints into the plant growing area.

A forced warm air heating unit was more satisfactory than either of the convected heat systems. The combustion and heating chambers were separated, and gas fumes were more readily eliminated through a vent stack. Even with the forced warm air unit fumes from the combustion chamber occasionally blew down the vent stack, through the combustion chamber and into the greenhouse. The circulating fan collected these fumes and scattered them over the greenhouse. Such fumes induced severe injury to several kinds of plants. Tomatoes were very sensitive and provisions had to be made to keep these fumes from the area where tomatoes were grown to maturity.

Work in Virginia (5) showed no difference in the temperature of two plastic greenhouses when one was equipped with a convected heat system and the other with a forced warm-air furnace. However, a significant difference in the amount of moisture in the greenhouse atmosphere was noted. The average relative humidity was 83.3 percent in the house equipped with a convected heater and 66.8 percent in the one equipped with a forced warm-air furnace.

Watson (7) demonstrated at the Delta Branch Experiment Station the value of circulating the air near the ground level and near the ceiling in a plastic greenhouse.

Several heating systems have been tested at Mississippi State University in connection with plastic greenhouse work during the past several years. All systems studied were equipped with thermostatic controls and each maintained satisfactory temperatures at the level of the thermostat. Two types of convected heat systems are shown in Figure 1. The one on the left has the fan located near the exhaust end of the heating ducts. The one on the right has the fan located near the burner. Tomatoes growing in the house heated by either convected heat system exhibited leaf epinasty and severe flower drop. The various stages of plant injury are shown in Figure 2.

A forced warm-air furnace (Figure 3) was located near one end of a greenhouse. It had separate combustion and heating chambers. The combustion chamber was provided with a vent stack for eliminating the products of combustion from the house. The heating chamber was provided with a forceful fan which circulated the warm air in the greenhouse. Gas injury was less frequent from this unit and never so severe as with the convected

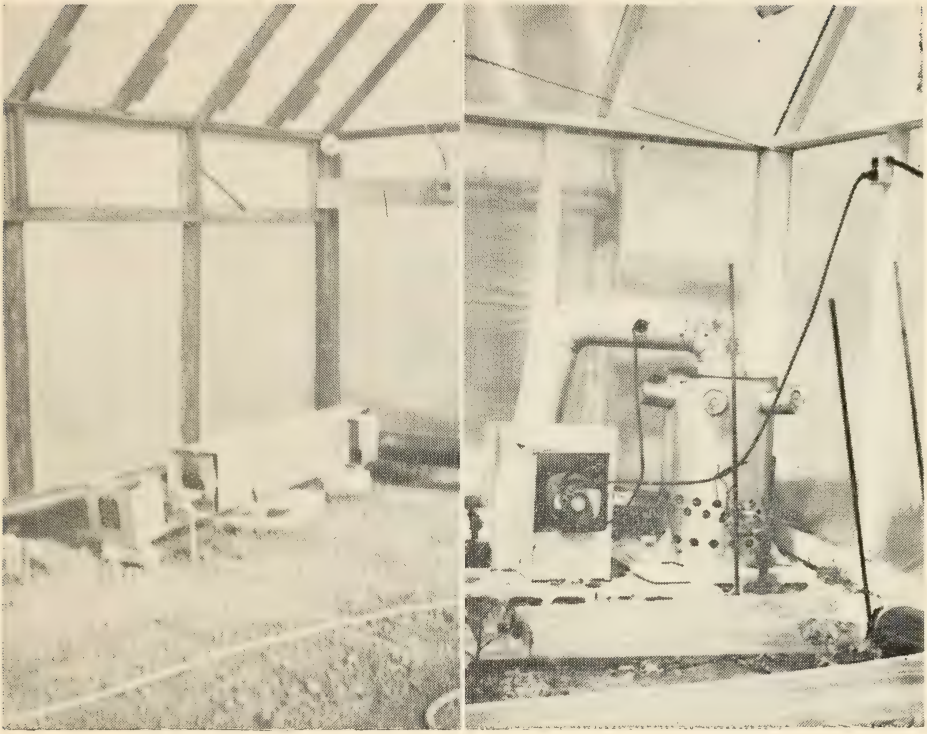


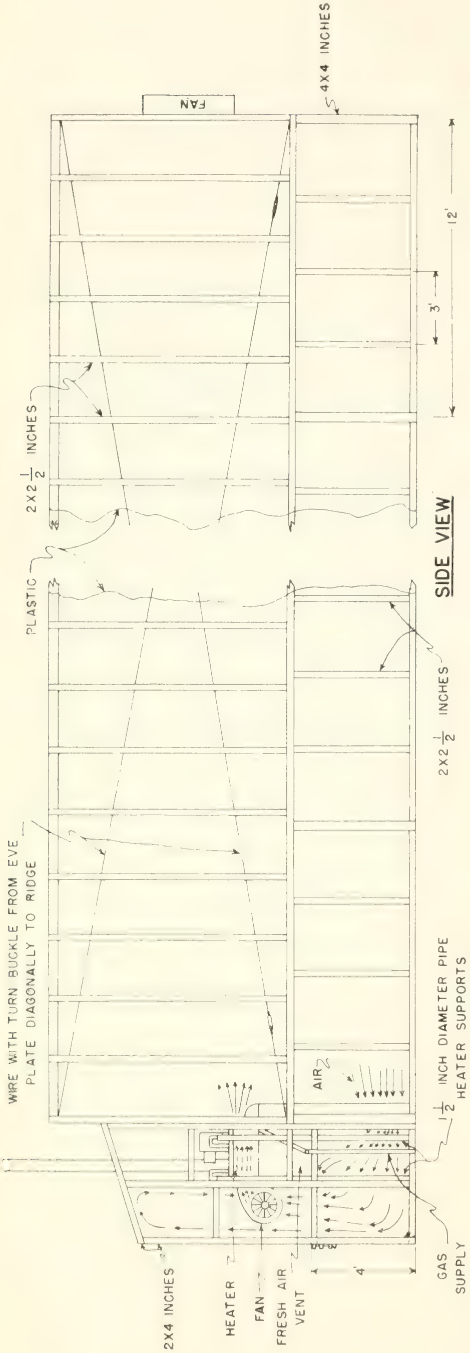
Figure 1. Two convected heat systems. Left—the blower is located near the exhaust end of the radiating duct. Right—the blower is located near the heater end of the radiating duct. These systems permit gas fumes to seep into the greenhouse and injure tomato plants.

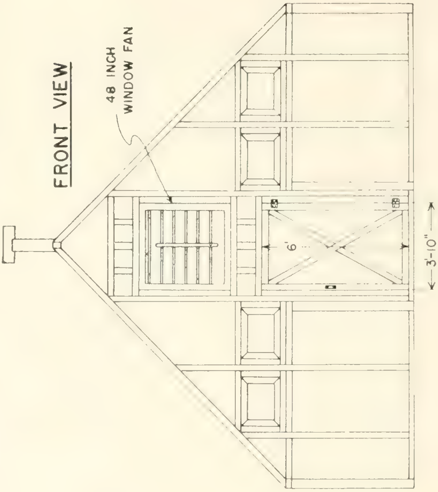
heat systems. Some damage was observed and yields were reduced about 15 to 20 percent.

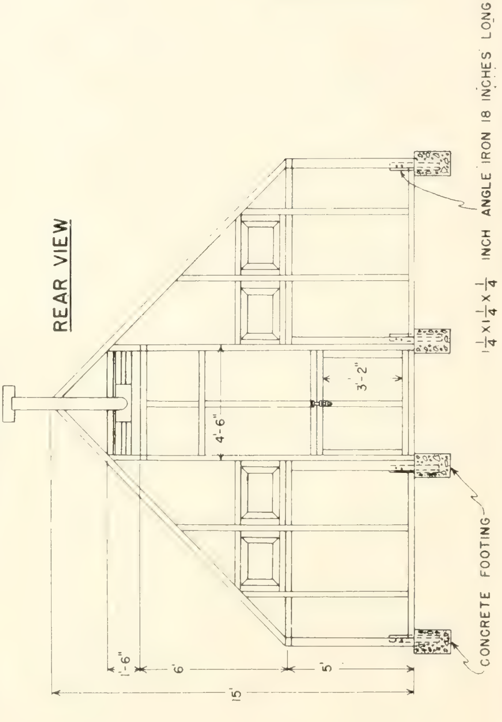
Based on these studies, the Horticulture Department in cooperation with the Agricultural Engineering Department devised a system which completely eliminated all products of combustion from the plant growing area.

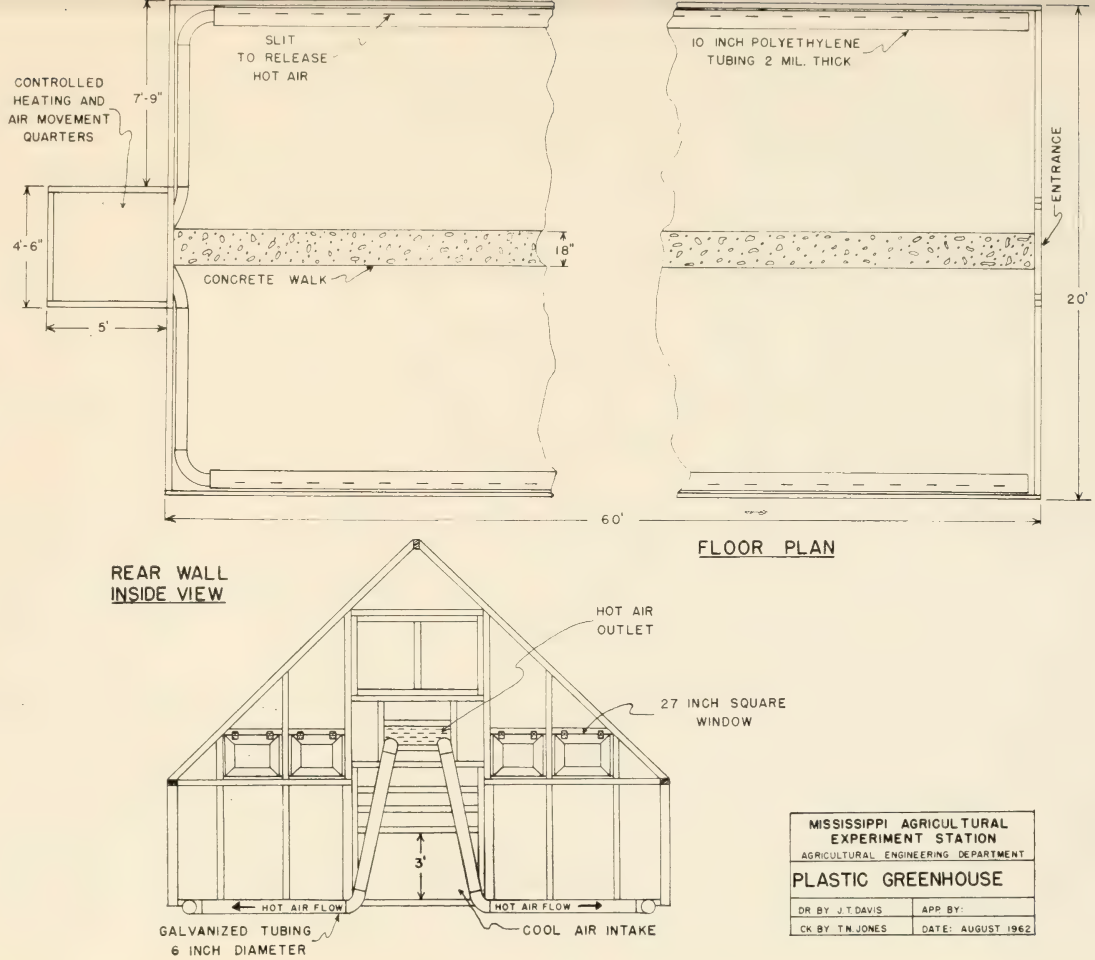
A forced warm-air furnace as shown in Figure 3 was located in a plastic covered heating and air movement quarters of unique design and attached to one end of a greenhouse. The heater used was a 150,000 BTU input forced warm-air furnace equipped with automatic controls, thermostats, separate combustion and heating chambers and a vent stack. The unit included a fan which may be operated on a manual or automatic setting. When operated on the manual setting the fan ran continuously and the heat cycled on and off as required by a thermostat. On automatic the fan cycled on and off with the heater.

The heating and air movement quarters (see Diagrams pages 6 and 7) was divided into two compartments. One compartment contained the gas lines, pilot light, combustion chamber and vent stack. This compartment was separated from the radiating units of the furnace by metal partitions, and from the greenhouse and air movement compartment by plastic partitions. All gases that may have seeped from the lines and fumes that blew-back down the stack were collected in the combustion compartment. They were eventu-


SIDE VIEW
FAN
4X4 INCHES
12'
3'
2X2 1/2 INCHES
PLASTIC
2X2 1/2 INCHES
WIRE WITH TURN BUCKLE FROM EVE PLATE DIAGONALLY TO RIDGE
AIR
1 1/2 INCH DIAMETER PIPE HEATER SUPPORTS
4'
GAS SUPPLY
2X4 INCHES
HEATER
FAN
FRESH AIR VENT


FRONT VIEW
48 INCH WINDOW FAN
6'
3'-10"


REAR VIEW
4'-6"
3'-2"
1'-6"
6'
5'
15'
1 1/4 X 1 1/4 X 1/4 INCH ANGLE IRON 18 INCHES LONG
CONCRETE FOOTING


SLIT
TO RELEASE
HOT AIR
10 INCH POLYETHYLENE
TUBING 2 MIL. THICK
CONTROLLED
HEATING AND
AIR MOVEMENT
QUARTERS
7'-9"
4'-6"
5'
CONCRETE WALK
18"
ENTRANCE
20'
60'
FLOOR PLAN
REAR WALL
INSIDE VIEW
HOT AIR
OUTLET
27 INCH SQUARE
WINDOW
3'
HOT AIR FLOW
HOT AIR FLOW
GALVANIZED TUBING
6 INCH DIAMETER
COOL AIR INTAKE
MISSISSIPPI AGRICULTURAL
EXPERIMENT STATION
AGRICULTURAL ENGINEERING DEPARTMENT
PLASTIC GREENHOUSE
DR BY J.T. DAVIS
APP. BY:
CK BY T.N. JONES
DATE: AUGUST 1962

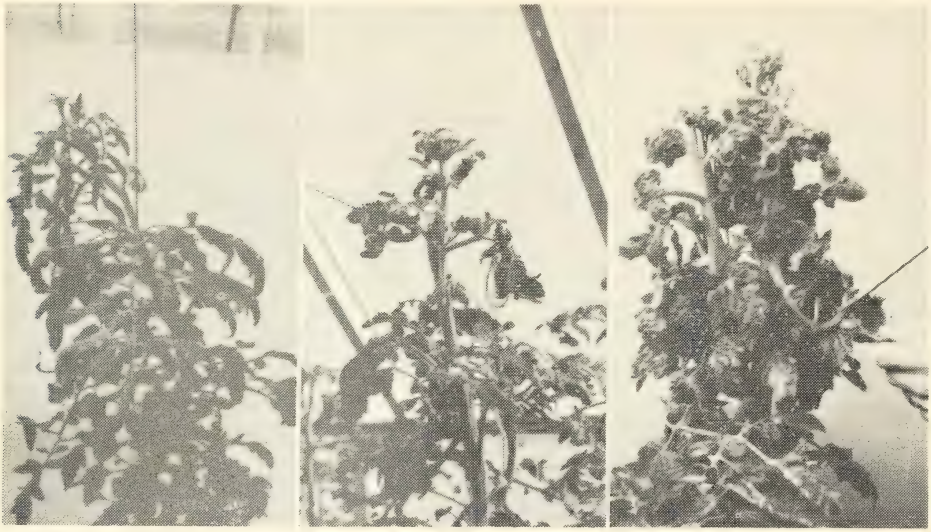


Figure 2. The progressive stages of injury to tomatoes from gas fumes seeping into the plant growing area from the combustion chamber of a heater. The plant on the left shows slight flagging of the leaves but has normal flowers. The middle plant exhibits moderate leaf distortion and reduction of individual flower size. The plant on the right demonstrates severe leaf distortions and no flower formation.

ally eliminated through the vent stack. Fresh air was admitted to the combustion compartment for proper gas combustion through vents in the outside plastic wall.

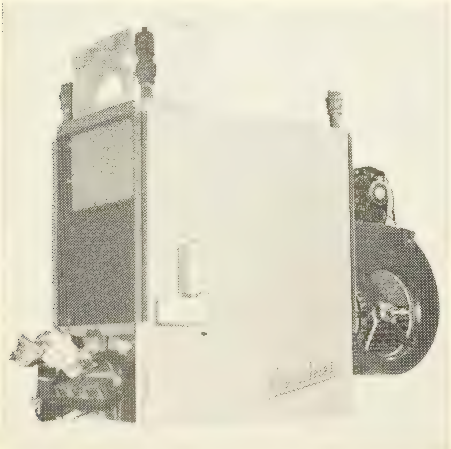


Figure 3. Forced warm-air furnace with a separate combustion chamber are vented through a stack attached near the top of the unit. A fan at the rear of the unit forces air through the heating chamber.

The other compartment contained the radiating units of the furnace and the circulating fan. It was not partitioned from the greenhouse and is referred to as the heating and air movement compartment. Cool air was pulled from the greenhouse through a three-foot opening near the ground level and forced into the heating and air movement compartment by the heater fan. The air was heated and then returned to the greenhouse through a hot air outlet located about ten feet above the ground level. Air movement through this compartment is shown by the arrows in the diagrams.

Most of the heated air was forced along the ceiling toward the front of the house, but a small portion was forced through six-inch diameter ducts (10 inch flat plastic tubing) along the base line of the greenhouse. After the air was moved toward the front, it was then pulled among the plants and back into the heating and air movement compartment. With the hot air outlet well above the plants, the problem of blasting hot air directly on the plants was eliminated. The system gave excellent air circulation in the greenhouse. Since the air contained no harmful gas fumes, it was retained and recirculated in the greenhouse. A thermostat properly located among the plants cycled the heat on and off as needed.

A door located at the rear of the heating and air movement compartment was of value for admitting fresh air for cooling and ventilating the greenhouse. It was opened on cold sunshiny days when only a little ventilation was needed. The heater fan pulled the cold air through the door and exhausted it into the greenhouse near the ceiling. The cold air was blended with the hot air in the greenhouse and prevented blasting cold air directly on the plants.

Detailed studies were made of the operation of this system and the results compared with those of an identical forced warm-air furnace located inside a greenhouse (Figure 4). Adequate ventilation was provided the unit located inside the house for proper gas combustion and stack operation through vents to the outside. The combustion chamber was not partitioned from the plant growing area. The unit was located 85 inches above ground. No special provisions were made to control air circulation near the ground or ceiling levels. The circulating fan cycled with the heat.

Thermostats for controlling the temperature of each heating system were located midway of a 20 x 60 foot greenhouse and 60 inches above ground level. They were set to turn the heat on at 61 degrees F.

Hygro-thermograph recorders were located near the thermostats and the temperatures charted at the 4-inch, 100-inch and 175-inch levels (Figure 4) Data were taken from these charts on 23 selected nights during the winters of 1961 and 1962 when the outside minimum temperatures were between 15 and 20 degress F. The averages of these data are presented in Table 1.

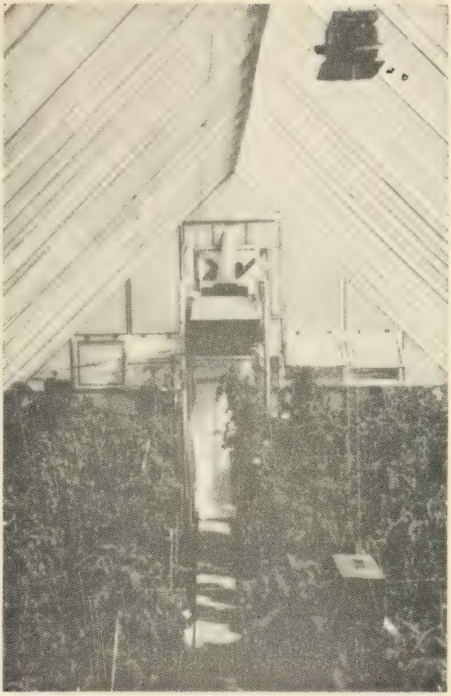


Figure 4. Forced warm-air furnace suspended inside a greenhouse well above the plants. Also shown in right foreground are two hygrothermograph recorders. A third recorder, not shown, was located near the ground level.

Forcing the air through the heating and air movement quarters raised the temperature of the greenhouse about six degrees F. near the ground level and lowered the relative humidity. In contrast, the temperature near the ceiling was reduced and the relative humidity increased.

The average of the maximum temperatures at all elevations was about three degrees lower in the house equipped with the heating and air movement quarters than in the one with the heater located inside the greenhouse. The heating and air movement system raised the average minimum temperature one degree. The difference in mean temperature between the two houses was one degree.

The main physical effect of the heating and air circulating unit was to maintain a more constant temperature at various elevations in the greenhouse. This was accomplished by forcing the warm air near the ceiling downward and the cool air near the ground level upward. The continuous blending of the air at the two levels resulted in the more uniform temperature within the plant growing area.

The effect on relative humidity was due mainly to the change in temperature. Increasing the temperature at a given elevation lowered the relative humidity. Conversely, reducing the temperature increased the relative humidity.

Although temperature control was improved in the plant growing area by the heating and air movement system, its most important feature has been the complete elimination of gas injury on tomatoes grown to maturity.

The device was arranged so that the air inlet was near the ground and the furnace and air return were near the ceiling and above the plants. Since air movement is mechanically controlled by a motor-driven fan, there is no reason to prevent reversing the direction of air flow. The furnace and return duct would be located near the ground and the inlet duct near the ceiling. With the furnace near the ground all the exhausted air should be conveyed by ducts to various parts of the greenhouse as needed. The ducts may be thin plastic sleeves which are rather inexpensive.

Results during the last seven years show that a 150,000 BTU forced warm-air furnace was capable of maintaining a 50-degree differential between inside and outside temperatures of a 20 x 60 foot plastic covered greenhouse. As a general rule, this size heater was barely adequate for this area.

The test houses were covered with one layer of 4-mil polyethylene plastic. Covering the two layers separated by an inch air space conserves about 25 percent of

Table 1.—The effect of controlled air circulation through a heating and air movement quarters on the average maximum and minimum temperature and relative humidity at different elevations in a plastic greenhouse.

Air Circulation[1]	Recorder elevation Inches	Temperatures Degrees Fahrenheit Maximum	Minimum	Relative humidity Percent
Not Controlled	4	54.1	51.8	94
Controlled	4	60.1	58.3	82
Not Controlled	100	70.2	61.8	78
Controlled	100	64.7	61.5	67
Not Controlled	175	86.9	74.6	44
Controlled	175	77.8	71.3	58
Not Controlled	----	70.4	62.7	72
Controlled	----	67.5	63.7	69

[1] "Not Controlled" — a forced warm-air furnace located inside the greenhouse.

"Controlled" — a forced warm-air furnace located in the heating and air movement quarters. Air picked up near the ground level was circulated through the heating and air movement quarters and exhausted back into the house at the 8 to 10 foot level.

Table 2.—Gas consumption and cost of heating a 20 by 60 foot greenhouse covered with one layer of 4-mil polyethylene plastic at State College, Mississippi.

Year	Consumption 100 Cu. Ft.	Cost Dollars	Cost high month
1959	1489	$125	Feb. $30.02
1960	1769	$142	Dec. $35.31
1961	1782	$141	Feb. $34.39
1962	1943	$151	Jan. $41.05

the heat loss; however, in Mississippi the cost of the additional layer is about as great as the extra fuel consumed by heat loss through a single layer.

The number of cubic feet of gas consumed and the cost of heating a 20 x 60 foot house covered with one layer of plastic is shown in Table 2. These cost figures were based on natural gas rates in the Starkville, Mississippi, area in March of 1963. In limited tests L.P. (butane) gas was equally satisfactory as a fuel except it was more expensive.

Tomato yields have been excellent from plastic greenhouses that were properly heated and where sound cultural practices were followed. Based on our experiments, two crops may be grown profitably each winter in the northern part of Mississippi. The first or fall crops have yielded about 2,400 pounds per 20 x 60 foot greenhouse and the second or winter crops have yielded about 2,700 pounds. Figure 5 demonstrates the type plant growth and fruit set to be expected. The market demand and prices per pound have been very good. Prices ranged from 25 to 35 cents per pound.

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BULLETIN 667 JUNE 1963

An Economic Analysis of

Custom Work On Farms In The Yazoo-Mississippi Delta

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Agricultural Experiment Station
Henry H. Leveck, Director

State College Mississippi

in cooperation with
Farm Production Economics Division
Economic Research Service
United States Department of Agriculture

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SUMMARY AND CONCLUSIONS

Custom work is not new in the agriculture of the Mississippi Delta but it has made most of its important growth in the last 10 years. Much of this rapid expansion of custom services has centered around the harvesting of soybeans that have been planted on cropland released by the acreage restrictions on cotton.

In 1959, over 93 percent of the farmers in the Delta area of Mississippi hired machine work done on their farms, with an average expenditure of $1,067 per farm for this service. Based on this figure, total custom work amounts to more than 18 million dollars annually in the area.

Prices charged for custom work in the Delta vary more because of differences in machine size and power source than area differentials. Other factors that affect the charges are completeness of the service offered, distance traveled, field and crop conditions, crop seasonality, weather conditions, and labor scarcity.

Farmers are concerned over the trend toward higher machinery investment and are investigating the possibilities of custom work as an alternative for certain jobs. A procedure for evaluating this alternative in specific farm situations is presented in this report.

Some machinery dealers feel that the high cost of farm machinery and equipment is hurting sales, and will probably consider the newer practice of equipment rental if sales remain relatively slow.

Custom work is increasing in the Delta and will probably continue to expand if custom operators can adapt their services to the changing farm situation. Custom work has grown rapidly for certain crops and operations that compete for time and labor with the production and harvesting of cotton. Many custom operators intend to modify their service plans to fit the changing pattern of Delta agriculture.

AN ECONOMIC ANALYSIS OF CUSTOM WORK ON FARMS IN THE YAZOO-MISSISSIPPI DELTA

By MORRIS M. LINDSEY[1]

The Yazoo-Mississippi Delta[2] is a highly specialized farming area encompassing 11 counties in Mississippi that are flanked by the Mississippi and Yazoo rivers. The specialty crop is cotton which accounts for over 80 percent of the gross sales of farm products in the area. The other crops grown ranked in the order of acreage harvested are soybeans, oats, corn, rice, and wheat.

Mechanization is highly developed in the Delta with few farm jobs remaining that have not been adapted to mechanical handling. Weed and grass control still requires more hand labor than any other farm job. High labor and power requirements plus an unusually critical time period for many of the jobs has, in the past, required the independent ownership of most of the machinery and equipment. By conventional standards many farms in the Delta are overpowered, but variable weather conditions coupled with highly seasonal jobs often cause high power peaks that are reached only once or twice during a growing season.

Approximately 15 percent of the farmers plant almost 70 percent of the cotton acreage in the Delta and probably produce more than 70 percent of the crop. These larger farms are usually more mechanized and use more advanced technology than the smaller farms. A recent study[3] revealed that those Delta cotton farms having 300 or more acres in cotton had an average of 12.2 tractors per farm in 1957, and 9.7 of these were classified as large tractors. Investment in machinery and equipment on these farms ranged from $75,000 to $150,000, with certain items of machinery and equipment valued at $25,000 to $40,000 per farm being used less than 15 days per season.

Many advances in mechanization in specialized cropping areas are the result of the development of new type machines. These machines are usually characterized by high initial cost, high yearly repairs, and short life. They require skilled operators, and frequently have capacities considerably in excess of the amount of work usually found on an individual farm. These are all factors conducive to custom operation. Custom work enables more farmers to use the new machine and provides the machine owner with enough volume of work to reduce fixed costs per unit of performance.

CUSTOM WORK IN THE DELTA

Some custom work has been going on in the Delta for many years, but the bulk of the services now offered have become available during the last 10 years. Farm size in the Delta has tripled in the past 10 years, having increased from an average of 60.2 acres in 1949 to 197.2 in 1959 (table 1). In 1949, 73 percent of the farmers reported an average of $260 machine hire (custom work) per farm, while in 1959 about 93 percent reported machine hire, with an av-

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[1] Agricultural Economist, Farm Production Economist Division, Economic Research Service, U.S. Department of Agriculture, stationed at the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Miss.

[2] For the remainder of this report the Yazoo-Mississippi Delta will be normally referred to as "the Delta."

[3] "Labor and Technology on Selected Cotton Plantations in the Delta Area of Mississippi, 1953-57." LeRay, Nelson, Jr., and Crowe, Grady B., Miss. Agri. Expt. Sta., April 1959.

Table 1.—Trend in number and size of farm, in acreage of major crops, in labor and machine work hired, Yazoo-Mississippi Delta[1].

Item	Unit	1949	1954	1959
Number of farms	No.	56,739	44,359	18,703
Average farm size	Acres	60.2	73.7	197.2
Farm reporting $5,000 or more gross sales	Pct.	6.5	12.6	20.6
Tractors per farm	No.	‘2.5	2.9	3.5
Farms reporting machine hire	No.	41,617	35,954	17,391
Farms reporting machine hire	Pct.	73	81	93
Cost of machine hire per farm reporting	Dol.	260	268	1,067
Farms reporting hired labor	No.	23,019	16,602	8,648
Farms reporting hired labor	Pct.	[2]41	[2]37	[2]46
Cost of hired labor per farm reporting	Dol.	1,194	1,296	3,729
Major crops:				
Cotton	Acres	1,210,187	852,682	764,602
Soybeans	Acres	119,558	426,766	764,799
Oats	Acres	57,698	198,188	121,783
Corn	Acres	241,795	153,373	97,042
Rice	Acres	[3]5,000	[3]77,000	[4]42,551
Wheat	Acres	[3]15,000	[3]45,000	25,231

[1] From U. S. Census of Agriculture.

[2] Hired labor not residing on the farm.

[3] From Mississippi Agriculture Statistics, 1956, Base Book Supplement No. 2.

[4] The reduction in acreage of rice in 1959 from 1954 was due to acreage restrictions that became effective in 1955.

erage cost of $1,067 per farm reporting. This means over 18 million dollars was spent for custom work in 1959 by farmers in the Delta area of Mississippi—a substantial business for custom operators.

The nature and growth of custom work in the Delta has been basically defined by the changes in cropping patterns in the past 10 years. Certain custom services such as late-season poison applications on cotton by plane—a longtime custom service—have felt the strain of competition as cotton acreage planted in the Delta has gone down by more than 425,000 acres in the period 1954-1959.

Farmers have shown a marked tendency to avoid the more intensive enterprises in their search for profitable alternative uses for land and other resources released by the cotton acreage reduction. Cotton, considered the best cash crop in the Delta, is still a labor-intensive crop and farmers feel that any further competition for the already dwindling labor supply would be unwise. The trend has been toward the less intensive labor using crops such as soybeans, oats, corn, rice, and wheat. Soybean acreage increased from 119,558 acres in 1949 to 764,799 acres in 1959. This more than sixfold increase in 10 years places soybeans on an acreage par with cotton. The acreage planted to oats more than doubled in the 10-year period and rice and wheat are planted to the fullest extent within acreage allotments. Corn, the major feed grain grown when the mule was the chief power source in the area, continues to decrease in importance, with the current acreage only slightly more than one-third of the 1949 acreage.

As cotton acreages were reduced, many Delta farmers found their farms “overpowered.” The shift to soybeans, oats, wheat, and grain sorghums did not require any additional power and machinery for planting and cultivation, but the harvesting of these crops presented new problems and additional costs.

The self-propelled combine is a relatively new machine to Delta agriculture. Fields had to be carefully cleaned and headlands had to be widened and graded to allow the large machine to operate and turn around. Combine operators had to be trained to drive and service the new machines. When oats and wheat were ready for combining, the cotton crop offered serious competition for labor and power. Harvesting time for the rapidly expanding soybean acreage sometimes came during the very peak of cotton harvesting which strained the management, labor, and power resources to the limit.

Many farmers found that a solution to these various problems was custom harvesting. The custom harvest operation offered a complete service combination of management, machinery, and labor. The farm operator is free to perform other pressing tasks after contracting the harvesting of the supplemental enterprises. It is estimated that more than 50 percent of the small grains now grown in the Delta are custom harvested.

Custom Services Available

The custom services available in the Delta can be grouped under three major headings: (1) land tillage operations, (2) jobs involving airplane services, and (3) crop harvesting operations.

Land Tillage Services—Land tillage and preparation is done primarily by machines owned by the farm operator. Such tasks as plowing, disking, bedding, harrowing, planting, and cultivating are seldom if ever performed on a custom basis. In some few instances, farmers hire some heavy plowing or bush and bog disking during the off-season. This service is usually performed by a local farmer or custom operator.

Major drainage ditches on Delta farms are cleaned and reworked periodically; this job is almost always a custom operation. Draglines with buckets of one-half yard and one-yard capacity are the chief pieces of equipment used for this work. The custom operator furnishes the machine and operator and performs the job supervision necessary. Because of the limited work of this nature found on the average farm and occurring only once every few years, most Delta farmers will continue to hire custom operators to have this job done.

Deep subsoiling, or "chiseling," is a rapidly growing tillage practice in the area. Chisels may vary from 18 to 26 inches in depth, and considerable power is required to pull these tools when they are buried deep into the hard-pan of the soil. Most farmer-owned rigs consist of only one chisel, pulled by a large row tractor rated at about 45 horsepower. The custom rigs for deep subsoiling have two or three chisels and are usually pulled by a crawler-type tractor such as the TD-14 or HD-20.

Aerial Services—Planes have been used in Delta agriculture for many years. They were first used in the area to apply insecticides on cotton after the plants had reached a point in their growth which inhibited the passage of ground machines. Planes still perform this vital service on many farms. Plane service also has been expanded to include such jobs as the planting and fertilization of small grains and cover crops, and also for applying weed control chemicals on small grains. Most of the defoliation of cotton in preparation for mechanical picking is done by plane. A few operators of large farms own and operate their own planes, but the bulk of the work is done by flying services on a custom basis.

Harvesting Services—Custom work has become more important in the harvesting and storing of Delta field crops. Any operator with a mechanical cottonpicker can usually find custom work for his machine, reflecting the trend toward mechanical picking. Naturally, the operators who offer more complete services will get the first choice, but a considerable amount of cotton is picked by the operator having only one picker.

Custom combining of grain has really come into its own in the Delta in the last 10 years. This reflects the remarkable increase in the acreage of soybeans and the acceptance of the self-propelled combine. Competition between custom operators in some areas of the Delta has been the strongest in the combining field.

Performance Rates and Custom Charges

Schedules of custom performance rates and prices charged for these services were obtained from 71 custom operators in the Delta. Some operators performed only one service while others performed as many as six custom jobs. Twenty-two of the operators surveyed stated that the custom operation of farm equipment was their major source of income and six of them were full-time custom operators.

Charges for particular services varied little among custom operators. In some cases, custom operators made adjustments in charges to compensate for distances longer than normal between jobs or for smaller work volumes. Combining and cottonpicking were the only services that attracted custom operators from areas outside of the Delta.

Performance rates were high in most cases of custom operation. This was attributed to specialization of tasks, well-trained workers, good machinery maintenance programs, and careful supervision. Custom operators thought they did better and faster jobs than most farmers and that larger work volumes allowed them to price their services to the farmer at a cost he could not duplicate with his own equipment.

Most pricing of custom harvest operations in the Delta is on a bushel or pound basis. Yields for most crops are usually high and rates based on these yields have usually been satisfactory to the operator. In many instances, the charges for custom harvesting is based on the cleaned weight or volume of the crop so that the farmer does not pay for trash and foreign matter that may accompany the harvested product.

Heavy machine work such as ditching that occurs at various points about the farm is usually priced by the hour while heavy machine work such as disking that covers a measured area is usually priced by the acre. Custom services performed by plane are most often priced by the acre or pound of material applied. A schedule of jobs performed by custom operators with the equipment used, performance ratings, and unit charges for 1960 are shown in table 2. These performance rates and charges apply generally to the last few years and probably will also apply quite well to the near future.

COSTS OF OPERATING SELECTED MACHINES

In order to compare custom work with work performed by farmer-owned machinery and equipment it is necessary, among other things, to have a schedule of costs for the major machines involved. Most of the cost data needed were available from "Budgets for Major Farm Enterprises in the Mississippi River Delta of Arkansas, Louisiana, and Mississippi." Mississippi Agricultural Experiment Station, AEc. M. R. No. 30, June 1961.

Fixed and Variable Costs

Some costs of owning farm machinery and equipment occur whether or not the equipment is used at all. These fixed costs include depreciation, interest on investment, insurance, and storage. In contrast, certain other costs vary directly with use of the machine. These include fuel, oil, grease, repairs, and maintenance servicing, and are commonly referred to as variable costs. The schedule of costs presented in table 3 reflects an average for machinery and equipment commonly used in the Delta.

Table 2.—Custom services: power source, equipment use, performance rates, and prices charged, Yazoo-Mississippi Delta, 1960.

Job	Power source	Equipment	Average work rate hours per acre	Rate charged Unit	Price
			Hours		Dollars
Land tillage					
Ditching	self-powered	dragline (1 yd. bucket)	-.---	hour	18.00
Subsoiling	tractor, crawler	3 chisels 20"-26"	0.90	acre	7.50
Disking	tractor, large	10'-14' disk	0.25	acre	3.50
Aerial service[1]					
Planting small grains	plane	----------------	-.---	acre	1.00
Planting cover crops	plane	----------------	-.---	acre	.90
Fertilization	plane	----------------	-.---	lb.	.01
Defoliation — dust	plane	----------------	-.---	lb.	.03
Defoliation — spray	plane	----------------	-.---	acre	[2]1.50
Spraying and dusting	plane	----------------	-.---	acre	.85
Harvesting					
Combining oats	self-propelled	12' combine	0.50	bu.	[3]12.
Combining wheat	self-propelled	12' combine	0.50	bu.	.20
Combining rice	self-propelled	12' combine	0.91	bu.	[4].25
Combining soybeans	self-propelled	12' combine	0.60	bu.	[5].50
Combining corn	self-propelled	12' combine	0.60	bu.	[6].30
Picking corn	tractor, large	2-row picker	0.70	acre	7.00
Picking cotton	tractor, large	1-row	1.33	lb. lint	[7].05
Picking cotton	self-propelled	2-row	0.75	lb. lint	.05

[1] Flying service operators try to keep prices so that often-repeated operations are priced from $0.85 per acre to $1.00 per acre. Off-season and one-shot services are priced slightly higher.

[2] Charge varies with the amount of liquid applied per acre. The quantity of liquid applied per acre can vary considerably.

[3] Oats are combined for 10 cents per bushel. Close hauling will add 2 cents per bushel and longer hauls up to 5 cents per bushel.

[4] This price includes combining and delivery to the dryer.

[5] This price may vary and reflects delivery to the oil mill and price may be on the basis of delivered weights at the mill.

[6] Any range in price will be due largely to difference in charge for hauling.

[7] Some custom picker operators contracted two pickings at 5 cents per pound lint while others picked the first picking at 4 cents per pound lint and second picking at 6 cents per pound lint.

CUSTOM WORK VERSUS FARMER-OWNED MACHINERY

Farmers in the Delta already have heavy investment in machinery and equipment, and they are genuinely concerned that present trends indicate a further increase. Farmers are seeking ways to reduce the cost of owning and operating expensive equipment required in modern farming. The most common alternative methods of reducing these fixed costs are: (1) cooperative ownership of large equipment, (2) custom work, (3) swapping work and equipment, and (4) the relatively new procedure of equipment rental.

Cooperative ownership has not been very satisfactory in the Delta because of variable weather conditions, farm crops with a high degree of seasonality, and the complete independence desired by most farmers. The existing cooperative ownership is found among operators of smaller farms. Swapping work and equipment has resulted in the same conditions, in general, as cooperative ownership.

Farmers are taking a close look at custom work as a possible solution to their machinery and equipment problems.

Table 3.—Estimated life, hours of annual use, repairs as a percentage of new cost and cost per hour of use for selected machinery and equipment, Yazoo-Mississippi Delta, 1960.

Implement	Size	Length of life	Annual use	Repairs for life of machine as a percentage of new cost	Costs per hour of use		
					Fixed	Variable	Total
Powered equipment		Years	Hours	Percent	Dollars	Dollars	Dollars
Dragline	½ yard	20	1,500	100	4.13	3.92	8.09
Dragline	1 yard	20	1,500	100	5.78	5.23	11.01
Combine (rice)	12 ft. S.P.	10	200	80	5.59	4.07	9.66
Combine (corn)	12 ft. S.P.	10	200	80	4.55	3.43	7.98
Combine (oats-soybeans)	12 ft. S.P.	10	200	80	3.41	2.73	6.14
Cottonpicker	1 row	10	150	100	5.20	5.47	10.67
Cottonpicker	2 row	10	200	100	11.23	9.49	20.72
Cornpicker (mounted)	2 row	10	200	50	2.77	2.12	4.89
Tractor (crawler type)	large	15	400	150	2.08	4.09	6.17
Tractor (crawler type)	medium	15	600	125	1.63	3.40	5.03
Tractor (wheel)	extra large	15	700	150	1.17	2.07	3.24
Tractor (wheel)	large	15	800	150	.53	1.26	1.79
Tractor (wheel)	medium	15	800	125	.32	.73	1.05
Truck	½ ton	4	20,000 mi.	----	cost per mile		.068
Truck	1½ ton	10	6,000 mi.	----	cost per mile		.235
Nonpowered equipment[1]							
Subsoiler	3 chisels	15	100	100	.14	.10	.24
Spray rig	8 row	10	150	100	.26	.19	.45
Grain cart	----------	20	250	60	.23	.08	.31
Trailer (cotton)	3 bale	15	200	80	.16	.07	.23
Disk harrow	tractor drawn 10-14 ft.	10	300	80	.54	.40	.94

[1] For the items of equipment not self-propelled the operating costs of the power unit used in conjunction with the equipment must be added in order to obtain total cost hour for the operation.

Many operators have used custom services for certain jobs, and many others are seeking facts to better enable them to make a decision between machine ownership and custom work.

Some major facts that a farmer should know to intelligently decide on whether to hire custom work or to purchase certain machinery and equipment are: (1) the price of the custom service, (2) the fixed and variable costs of the machinery and equipment under consideration, (3) value of farm labor, and (4) the job performance rate both for his own crew and for the custom operator. Tables 2 and 3 supply average figures for these items except for farm labor which may vary in value from farm to farm, and which may have no value if it has no alternative productive use and yet must be kept on the payroll. Wage rates for skilled machine operators are about $7.50 per day plus a bonus. It is assumed here that performance rates are the same for farmer-owned equipment as for custom equipment of the same size.

The Break-Even Point

In comparing custom work with farmer-owned equipment, the size of the job at which neither system has an advantage is commonly called the break-even point. At this point there is no measurable difference between the two alternatives. The computation of the break-even point requires first a comparison of the custom charge with the out-of-pocket machine and labor costs of doing the job with owned equipment. The difference, which can be called the net cost of custom work, is then divided into the annual fixed cost of the machine or machines in question to arrive at the break-even point. If the power source is already available on the farm, the fixed cost of the power unit does not affect the decision and should not be included in the computation. However, where the equipment under consideration is a self-propelled unit or if the job requires additional power units not already on the farm, the fixed cost must be included.

Computing Break-Even Point for Single Unit Equipment—The break-even point expressed in hours of work per year can be determined as indicated above by dividing the annual fixed cost of the equipment in question by the net hourly cost of the custom service. It is then a simple matter to divide the break-even point in annual hours by the performance rate (hours per acre) to find the break-even point in acres per year as shown in Example 1.

Example 1

Farmer A has 200 acres of land that requires disking during the late winter. His old disk is worn out and he is contemplating the purchase of a new 14-foot tandem disk to do the job. A custom operator will double-cut the 200 acres for $3.00 per acre. The new disk will cost about $1,250. It will handle about 2 acres per hour, and will last 10 years. During this time he will spend about $1,000 on repairs on the disk. He will use an extra large wheel type tractor that he already owns to pull the disk. The farm labor involved has alternative productive use. He is debating the wisdom of buying the new equipment or to avail himself of the custom service. The decision can be made on the basis of the following computations:

It is undoubtedly to the advantage of Farmer A to purchase the disk and do his own work. If he had less than 116 acres of disking per year it would be best to hire the work done.

Computing Break-Even Point for Multiple Unit Equipment—The method used to compute the break-even point for a custom service that includes several units of machinery and equipment is the same in principle as for a single machine, but is more complex as shown in Example 2. A value should be included for all labor freed by the custom service if that labor has alternative productive use or can be removed from the payroll.

Example 2

Farmer B has 340 acres of oats that will yield 60 bushels per acre. He does not own a combine but has all the necessary tractor and truck power for hauling grain to storage. He can get a contract for 10 cents per bushel plus 2 cents per bushel for hauling the oats 2 miles to storage. A 12-foot self-propelled combine will cost $6,250 and will last 10 years. He wishes to compute the break-even point for custom combining versus buying and operating his own combine. The machinery combination in either case is one combine, one large tractor, two 1½ ton trucks, two grain carts, and a combine crew of 4 men. In the month of June he can expect to operate a combine about 9 hours per day and cover about 2 acres per hour, harvesting 120 bushels per hour. (See next page)

From:		6.00	Custom price per hour for disking
	0.40		Variable costs of disk per hour
	2.07		Variable costs of tractor per hour
	.75		Labor for 1 man-hour
Deduct:	3.22	2.78	Net cost to farmer per hour
Divide:	162.50		Annual fixed cost for disk
By:	2.78		Net cost of custom disking per hour
Result:		58.45	Break-even point hours per year
	116.90		Break-even point acres per year

From:		14.40	Equivalent custom cost per hour for combining oats
	2.73		Variable costs of combine per hour
	1.26		Variable costs of tractor per hour
	.52		Variable costs of two 1½ ton trucks per hour
	3.00		Labor, for 4-man crew per hour
Deduct:	7.51	6.89	Net cost of custom combining oats per hour
		682.00	Annual fixed cost of combine
		110.40	Annual fixed cost of two grain carts
Divide:		792.40	Total fixed cost of equipment
By:		6.89	Net cost of combining oats per hour
Result:		115	Break-even point hours per year
		230	Break-even point acres per year
		13,800	Break-even point bushels per year

Thus, it would be advantageous to Farmer B to buy the self-propelled combine. In fact, in this case any acreage in excess of 230 acres would favor ownership of the machine.

EQUIPMENT RENTAL VERSUS OWNED EQUIPMENT

A new alternative, for many farmers, to the problem of high ownership costs on high-priced, specialized equipment is the procedure of equipment rental. Recently, farmers and equipment dealers have been expressing considerable interest in the possibilities of this practice. Dealers have met with increased buyer resistance to many items of farm equipment that are characterized by high initial cost and low seasonal usage. Some farmers feel they cannot justify high capital outlay for a machine that will be used such a short time each year, while others feel that such ownership provides a "safety valve" in case custom services cannot be secured.

Except for isolated instances equipment rental has not been important on Delta farms.

How Equipment Rental Works

In general farm equipment manufacturers have not been highly favorable to the idea of equipment rental. This reluctance on the part of manufacturers to encourage machinery dealers to rent new equipment to farmers has resulted in most rental equipment being used machines that are owned outright by the dealers. However, this equipment is usually completely reconditioned by the dealer and usually functions as well as new equipment. Under almost all rental contracts the dealer agrees to service and maintain the equipment he rents out. The farmer obtains the equipment from the dealer and returns it upon the completion of the contract. The farmer furnishes fuel, oil, lubricants, and labor to operate the equipment.

Determination of Rental Rate — There can be no one set rule for determining or setting rates to be charged for equipment rental. Local conditions and farm practices will have great effect on the charge in any area. The National Retail Farm Equipment Association (NRFEA) has devised a rental agreement form that includes a formula for determining rental rates. The form can serve as a general guide to dealers who need some basis on which to start in the equipment rental business. The formula is based on the retail price of the equipment when it was new. The formula suggested by the NFREA is basically as follows:

1 percent of the new delivered retail price of the equipment for one 10-hour day.

5 percent of the new delivered retail price for 1 week.

15 percent of the new delivered retail price for 1 month.

25 percent of the new delivered retail price for 2 months.

33 1/3 percent of the new delivered retail price for 3 months.

Based on a new $12,100 one-row cottonpicker, the rental fee for 1 day would be $121, the weekly rate would amount to $605 or $86 per day, and the monthly rate would be $1,815 or $60.50 per day for this period.

The Decision: Own, Rent, or Custom Service—Assuming that equipment rental becomes available in the Delta as it has in some other agricultural areas, how should a farmer determine whether or not he should rent a particular machine or piece of equipment? First, he should know the costs of owning and operating the equipment under consideration. Second, he should know the approximate number of days the machine will be needed in order to estimate rental costs.

Probably the best way to illustrate the alternatives that the farmer may have is by example.

Example

Farmer A has a 150-acre cotton allotment and owns a 3-year old one-row cottonpicker. He has always used hand labor to pick that part of the crop that the machine could not pick. This particular year is characterized by good yields and consequently a heavy demand for hand picking and custom machine picking. In a twice-over picker operation, Farmer A has estimated that his owned machine can handle 125 acres in a good year and could possibly handle 150 acres twice-over in an extremely favorable year. Farmer A figures he must make some arrangement to pick from 100 to 150 acres of cotton that will yield approximately 800 pounds of lint per acre. He has estimated that about 500 pounds of lint will be open at the first picking and about 300 pounds of lint at the second picking.

Since limited numbers of laborers for hand picking are available, the alternatives that Farmer A has are: (1) the purchase of another cottonpicker, (2) contracting the crop to a custom picking operator, or (3) the rental of a cottonpicker from his local equipment dealer. We can assume a new one-row picker will cost $12,100. The custom operator will do the first picking for 4 cents per pound of lint and the second picking or scrapping for 6 cents per pound of lint as long as the yield does not drop below 100 pounds of lint per acre; or a one-row picker can be rented for about $3,000 for a 2-month period or the equivalent of $50.42 per day.

If the new machine has a life expectancy of 12 years with interest at 6 percent on an average investment of $6,050,

Table 4.—Costs per acre, once-over harvesting, with varying amounts of use, 1-row mechanical cottonpicker.

Acres picked[1]	Use rating	Depreciation[2]	Interest[3]	Repairs[4]	Operation[5]	Total
Acres		Dollars	Dollars	Dollars	Dollars	Dollars
50	Poor	20.17	7.26	4.03	3.11	34.57
100	Low	10.08	3.63	4.03	3.11	20.85
150	Fair	6.72	2.42	4.03	3.11	16.28
200	Average	5.04	1.82	4.03	3.11	14.00
250	High	4.03	1.45	4.03	3.11	12.62
300	Excellent	3.36	1.21	4.03	3.11	11.71
350	Maximum	2.88	1.04	4.03	3.11	11.06

[1] Once-over picking.

[2] Based on 12 years of life expectancy for a $12,100 machine.

[3] Based on 6 percent interest on the average investment.

[4] Based on repairs at 80 percent of new cost over machine life.

[5] Operational costs of fuel, oil, grease, operator labor, helper labor, tractor, trailer, hauling, etc.

Table 5.—Mechanical picking costs per pound of lint, by acres harvested and lint yield per acre, once-over and subsequent harvestings, 1-row picker.

Lint yield per acre	Acres harvested 50	100	150	200	250	300	350
	Cents	Cents	Cents	Cents	Cents	Cents	Cents
			First Picking				
100	35.32	21.35	16.53	14.00	12.37	11.21	10.30
200	17.66	10.68	8.27	7.00	6.19	5.61	5.15
300	11.77	7.12	5.51	4.67	4.12	3.74	3.43
400	8.83	5.34	4.13	3.50	3.09	2.80	2.58
500	7.06	4.27	3.31	2.80	2.47	2.24	2.06
600	5.89	3.56	2.76	2.33	2.06	1.87	1.72
700	5.05	3.05	2.36	2.00	1.77	1.60	1.47
800	4.41	2.67	2.07	1.75	1.55	1.40	1.29
900	3.92	2.37	1.84	1.56	1.37	1.25	1.14
			Second and Third Picking[1]				
100	7.89	7.64	7.39	7.14	6.87	6.64	6.39
200	3.95	3.82	3.69	3.57	3.45	3.32	3.20
300	2.63	2.54	2.46	2.38	2.30	2.21	2.13
400	1.97	1.91	1.85	1.79	1.72	1.66	1.60
500	1.58	1.53	1.48	1.43	1.38	1.33	1.28
600	1.32	1.27	1.23	1.19	1.15	1.11	1.06
700	1.13	1.09	1.06	1.02	.98	.95	.91
800	.99	.95	.92	.89	.86	.83	.80
900	.88	.85	.82	.79	.77	.74	.71

[1] No fixed costs are reflected since all such costs were included in the first picking.

the yearly fixed costs would amount to $1,371 (table 4). Repair costs for 200 acres harvested once-over equivalent would be $806 per year or $4.03 per acre. The operational costs of fuel, oil, grease, operator labor, helper labor, hauling, etc. amounts to $3.11 per acre. All fixed costs are charged to the machine during the first picking with repairs and operational costs only charged during second and third pickings. Fixed costs are handled in this manner because in some cases only one mechanical picking may be performed. This may be either the first picking and subsequent pickings may be made by hand or the first picking may be by hand labor and scrapping may be done by machine. In either case the figures under the heading "first picking" in table 5 would be used in order that fixed costs would be included. Where both or all pickings are done by machine it is simple to interpolate picking costs using both sections of table 5. The machine will be needed to harvest 100 acres in a twice-over operation. The first picking, based on 100 acres harvested once-over, will cost $21.35 per acre or 4.27 cents per pound lint based on a 500-pound lint yield per acre (table 5). The second picking of the 100 acres will cost $7.64 per acre or 2.54 cents per pound lint based on a lint yield of 300 pounds per acre. The total costs of picking will amount to $28.97 per acre in a twice-over operation for an average of 3.62 cents per pound of lint cotton harvested with each bale costing $18.10.

The custom operator will make the first picking for 4 cents per pound of lint harvested or $20.00 per acre or bale since the yield for the first picking is 500 pounds of lint per acre. The second picking of 300 pounds of lint per acre will cost 6 cents per pound of lint or $18.00 per acre. The total cost of two custom pickings will amount to $38.00 per acre for an average of 4.75 cents per pound of lint harvested or $23.75 per bale.

The rental machine will cost $50.42 per day based on a $3,025 charge for the 60-day period of October and November.

Based on past weather and field conditions a machine can normally operate 19 nine-hour days in October and 17 eight hour days in November for a total operating time of 307 hours for the 60-day period. Assuming 1.33 hours is necessary to harvest an acre, the machine will pick 230 acres once-over or 115 acres in a normal twice-over operation. The machine will pick 34.1 nine-hour days for a rental cost of $3,025 and an operational cost of $715.30. Total costs of $3,740.30 for the 60-day period will break down to $32.52 per acre or 4.06 cents per pound of lint harvested for a $20.30 per bale harvesting cost. These figures are for a twice-over operation yielding 800 pounds of lint cotton.

Harvesting Costs[4]

Machine	Per acre	Per pound of lint harvested	Per bale harvested
	Dollars	Cents	Dollars
Owned	28.97	3.62	18.10
Custom	38.00	4.75	23.75
Rented	32.52	4.06	20.30

The above illustration indicates that should the farmer feel that the conditions that exist this season will occur again with any frequency his best alternative is to buy a new machine. Purchasing a machine will save $2.20 per bale on harvesting costs over a rental unit and $5.65 per bale over custom harvesting costs. However, should the farmer consider this season a once-in-a-decade phenomena, the best choice may be a rented picker since a purchased unit may see only limited use for several seasons with the accompanying high harvesting costs per bale picked.

No value has been placed on the farmers labor and management that normally accompany harvesting with either an owned or a rented mechanical picker. A major consideration in custom harvesting is the fact that the farmer is free to pursue other tasks while the custom operator, to a large degree, assumes the management function during the performance of the custom service. The entire savings resulting from harvesting with an owned machine over custom picking would amount to $1,040 based on 115 acres yielding 184 bales of cotton. The savings span a 60-day period during which the farmer would be free to perform labor and management functions that might result in considerably more income than the $1,040 saved. These observations are included to indicate that the best alternative for one farmer may not be best for his nearest neighbor. Each situation should be evaluated separately and the decision should best fit the needs of the operator concerned. One method or tool has been illustrated here to aid the farmer in making a decision concerning the best method to harvest his cotton crop and no one method has been selected as best for all harvesting situations.

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[4] Twice-over picking operations.

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Greenhouse And Field Measurements Of Nitrogen Loss From A Sharkey Clay Soil As Influenced By Water-Logged Soil, Nitrogen Sources And Placement

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SUMMARY

In a greenhouse test a water-logged Sharkey clay soil lost all (150 ppm) of the applied nitrate nitrogen within a 16-day period.

A field experiment was conducted over a 4-year period to measure the influence of water-logged soil treatments, nitrogen sources and placement of these sources upon the amount of nitrogen loss from a Sharkey clay soil. The results of this experiment are listed below:

1. Nitrogen loss each year, from the non-water-logged soil was proportional to the amount of rainfall and mean temperature for the duration (20 days) of the experiment. The amount of nitrogen lost was greatest for the periods with the most rainfall and highest mean temperature.

2. Nitrogen loss, each year, from the continuously water-logged soil was proportional to the mean temperature for the duration (20 days) of the experiment. The amount of nitrogen lost was greatest for those periods with the highest mean temperature.

3. The 4-year average (nitrogen sources and placement averaged) nitrogen loss over a 20 day period from the non-water-logged soil was 45 pounds per acre compared to 92 pounds from the water-logged soil.

4. More nitrogen was lost from ammonium sulfate than from sodium nitrate in the non-water-logged soil. More nitrogen was lost from sodium nitrate when the soil was maintained under a water-logged condition.

5. Nitrogen loss was less when the nitrogen was placed 4 inches under the soil as compared to a surface application regardless of the water-logged soil condition and/or nitrogen sources. The greatest amount of nitrogen lost (118 pounds per acre) was from the water-logged soil where sodium nitrate was surface applied.

Greenhouse and Field Measurements of Nitrogen Loss From a Sharkey Clay Soil as Influenced by Water-Logged Soil, Nitrogen Sources and Placement of Nitrogen

By W. I. SPURGEON and P. H. GRISSOM[1]

The Mississippi Delta region of the state of Mississippi has about 70 percent of the total land in crop production. The soil types on which these crops are grown vary. However, about 45 to 50 percent of the total cropped area is Sharkey clay or very closely related soil types. Most of these soils have a very high clay content ranging from 30 to 60 percent. The predominate clay material is Montmorillinite. Practically all of these soils have poor internal drainage and usually have poor surface drainage.

The normal annual rainfall for the Mississippi Delta is 51.2 inches, with about 21 percent of this amount occurring from mid-March until mid-June. Frequent and extensive rainy periods may occur at any time during this period. The poorly drained clay soils may be subjected to water-logged conditions for periods of 5-20 days or more. A water-logged soil is saturated with water to the extent that practically all of the soil air is removed. These conditions may and usually do occur after nitrogen has been applied in Spring.

For several years nitrogen deficiency symptoms have been observed in cotton and corn growing on Sharkey clay and related soil types although the applied nitrogen was far greater than the crop could have used. Without exception the more severe nitrogen deficiency symptoms were observed following extensive rainy periods. It seemed apparent that nitrogen was being lost and that the loss was associated with rainfall.

Numerous laboratory studies have shown that nitrogen is lost from water-logged soils through the process of denitrification. In the absence of soil oxygen specific soil bacteria remove the oxygen from nitrate nitrogen. When oxygen is removed from the nitrates, a nitrogen gas is formed which is lost from the soil into the atmosphere. Nitrogen loss by this method is designated as denitrification.

The objectives of this study were to determine, by greenhouse and field experiments, the approximate nitrogen loss from a Sharkey clay soil as influenced by water-logged treatments, nitrogen sources and placement of nitrogen.

Greenhouse Experiment Procedure

In the greenhouse experiments the treatments were: (1) soil with no nitrogen and non-water-logged, (2) soil with 150 PPM (parts per million) of nitrogen and non-water-logged, and (3) soil with 150 PPM of nitrogen and water-logged. One part per million of nitrogen is equal to 2 pounds per acre. Four replications were used in all experiments. Air dried Sharkey clay soil (500 grams) was placed in quart milk containers. The soil moisture was adjusted to 45 percent with distilled water. Nitrogen as KNO_3 was applied in aqueous solution to individual soil containers. Appropriate treatments were water-logged with distilled water and maintained in this condition for a period of 20 days. The soil of the non-water-logged treatments was kept at a moisture level of 45 percent for the same period.

Soil samples from all treatments were analyzed for nitrate nitrogen after the nitrogen was added and before the water-logged treatments were initiated. Thereafter, soil samples were removed from each container of all treatments at 2-day intervals and analyzed for nitrate nitrogen.

Field Experiment Procedure

The field tests on Sharkey clay soil

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were conducted in August and September over a four-year period from 1957 through 1960. The experimental design was a split-split plot with 6 replications. The main plot treatments were (1) soil artificially water-logged for 10 and 20 days and (2) soil non-water-logged (with the exception of that which occurred through rainfall) for 10 and 20 days. The first sub-plots were nitrogen sources, sodium nitrate and ammonium sulfate. The second sub-plots were placement of nitrogen on the soil surface and drilled approximately 4 inches deep. The nitrogen was applied at the rate of 120 pounds of N per acre. The main plots were separated by double levees to control water on the water-logged plots and to prevent seepage of water into the non-water-logged plots.

After 10 days, plots water-logged for this period and the non-water-logged plots were sampled to a soil depth of 12 inches. A composite soil sample was obtained from 10 positions within each nitrogen placement plot by taking an equivalent number of samples from the band of nitrogen placement and midway between the bands of placement. After 20 days, the non-water-logged and 20-day water-logged plots were sampled by the same procedure. The soil samples were oven-dried at 55° C, ground to pass a 10-mesh screen and analyzed for ammonium and nitrate nitrogen. The amount of ammonium and nitrate nitrogen in the soil, plus the amount applied, minus that remaining after the 10- and 20-day periods was used to evaluate the nitrogen loss.

In 1957 soil samples from the 12- to 18-inch soil depth were analyzed for nitrate nitrogen to determine if any loss occurred by leaching. The small quantity (10-15 lbs./A) of nitrate nitrogen found below the 12-inch soil depth indicated that very little leaching had occurred. Denitrification is assumed to be the primary cause for nitrogen loss which occurred in the experiment.

Greenhouse Results

Figure (1) shows that the nitrogen loss was more rapid during the first 2 days after the soil was water-logged. The water-logged soil lost about 50 percent of the applied nitrogen during the first 2 days. The rate of nitrogen loss was rather consistent from the 2-12 day period and then decreased during the 12-16 day period. After 16 days all of the applied nitrogen had been lost, presumably by denitrification.

The nitrate nitrogen content of the non-water-logged soil with and without 150 PPM of nitrogen remained nearly constant throughout the 16-day period.

Field Experimental Results and Discussion

The field experiments were conducted each year from August 1 until September 31. The mean precipitation, at Stoneville Mississippi, (30 years), for this 60-day period from August 1 through September 31, is 2.77 inches. The mean temperature for the same period is 78.4 degrees Fahrenheit. This period of low normal rainfall was selected to partially eliminate the variation in nitrogen loss, from soil of the non-water-logged plots as influenced by soil water-logged from rain. The rainfall for the 20-day periods (duration of the experiment each year) was 7.20, 6.68, 3.55, and 2.37 inches in 1957, 1958, 1959, and 1960, respectively. Figure 2A shows the influence of rainfall on the nitrogen loss from soil of the non-water-logged plots. The nitrogen loss over a 20-day period from the non-water-logged soil was almost directly proportioned to the amount of rainfall. One exception occurred in 1957 when the lower mean temperature influenced the amount of nitrogen loss was less in 1957 than in 1958 because of the lower mean temperature.

Figure 2B illustrates influence of the mean temperature for the 20-day period on the nitrogen loss from soil of the water-logged plots. The mean temperatures for the 20-day periods were 75.8,

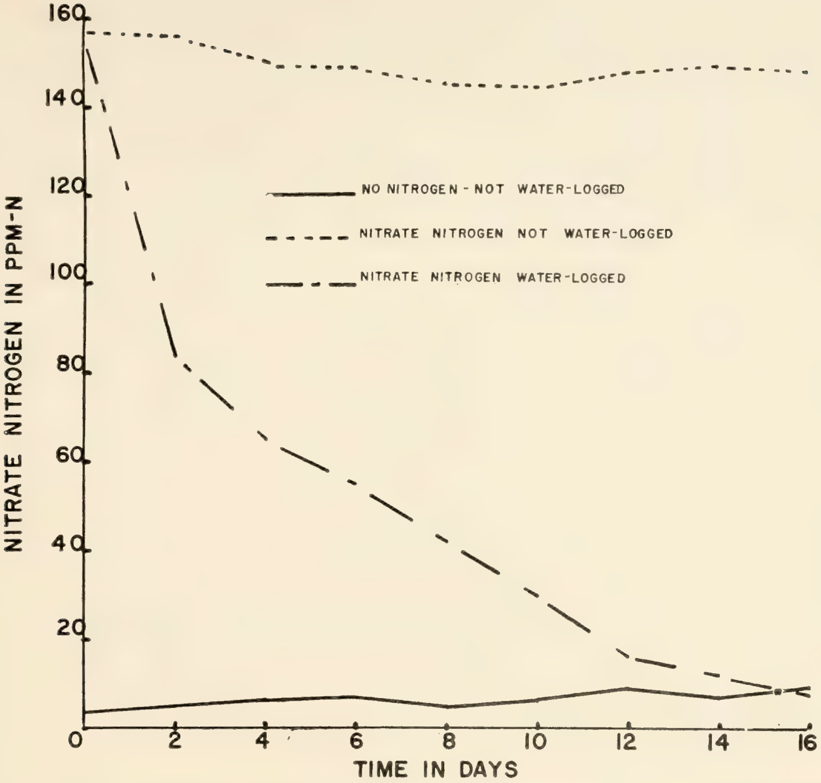


Figure 1. The influence of water-logged soil on the nitrogen loss from a Sharkey clay soil (average of 3 greenhouse experiments).

82.6, 80.1, and 71.3 for the years 1957, 1958, 1959, and 1960, respectively. Nitrogen loss from soil of the water-logged plots increased as the mean temperature increased (Figure 2B).

Nitrogen loss from a Sharkey clay soil as influenced by water-logged soil treatments is shown in Table 1. Nitrogen loss from soil of the non-water-logged plots was proportional to the amount of rainfall and mean temperature during the 10-day and 20-day periods. In 1957 most of the 7.20 inches of rain came during the second 10-day period. The nitrogen loss for the first 10 days was only 10 pounds per acre as compared to 41 pounds during the second 10 days. The rainfall pattern was reversed in 1958 with most of the 6.68 inches occurring during the first 10 days. The nitrogen loss was 55 pounds per acre the first 10 days and only 6 pounds the second 10 days.

As previously mentioned the nitrogen loss from soil of the water-logged plots was proportional to the mean temperature. The experiment was conducted during August in 1958 and 1959 and in September for the years of 1957 and 1960. The mean temperature was higher during the first 10 days when the experiment was conducted in August with greater nitrogen loss occurring during this 10-day period. The loss for the 20-day period was higher during 1958 and 1959 because of the higher mean temperature.

The 4-year average shows that the ni-

FIGURE 2A - EFFECT OF RAINFALL ON THE NITROGEN LOSS FROM A SHARKEY CLAY SOIL (NON-WATER-LOGGED PLOTS).

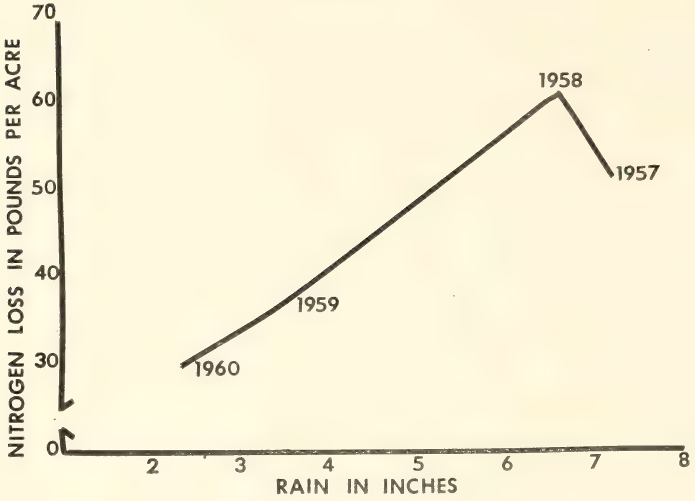
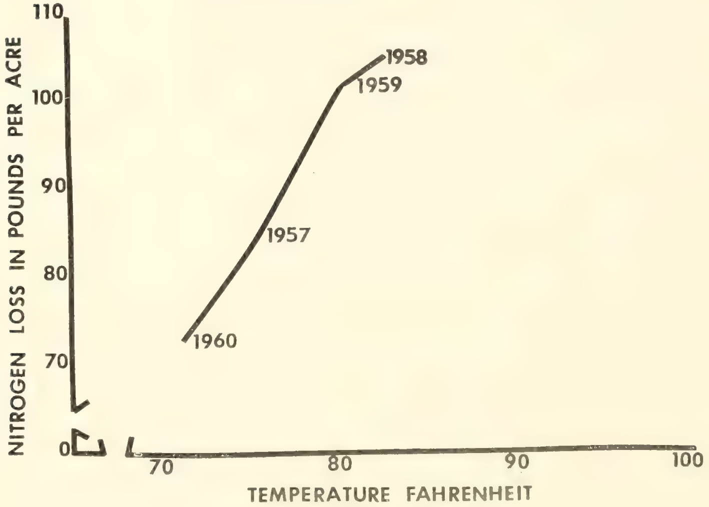


FIGURE 2B - EFFECT OF TEMPERATURE ON THE NITROGEN LOSS FROM A SHARKEY CLAY SOIL (WATER-LOGGED PLOTS).



trogen loss from soil of the water-logged plots was twice that of the loss from soil of the non-water-logged plots.

Nitrogen loss as influenced by two sources of nitrogen is shown in Table 2. The four-year averages for both 10- and 20-day periods, show very little difference between ammonium sulfate and sodium nitrate with respect to the amount of nitrogen lost from the non-water-logged soil. There was more variation in the degree of nitrogen loss between years with

Table 1.—Nitrogen loss from a Sharkey clay soil as influenced by water-logged soil treatments (Nitrogen sources and placement averaged).

	10-Day period		20-Day period	
Year	Not water-logged[1]	water-logged	Not water-logged	water-logged
	Lbs./A of ammonium plus nitrate nitrogen lost			
1957	10	32	51	85
1958	55	68	61	105
1959	28	97	37	102
1960	14	52	30	73
4-year average	27	63	45	92

[1] Not water-logged with the exception of that occurring through rainfall.

Table 2.—Nitrogen loss from a Sharkey clay soil affected by 2 nitrogen sources (nitrogen placement treatments averaged).

	10-Day period				20-Day period			
	Not water-logged		water-logged		Not water-logged		Water-logged	
Year	Ammonium sulfate	Sodium nitrate	Ammonium sulfate	Sodium nitrate	Ammonium sulfate	Sodium nitrate	Ammonium sulfate	Sodium nitrate
	Lbs./A of ammonium plus nitrate nitrogen lost							
1957	22	0	29	36	53	50	81	89
1958	34	76	45	81	39	82	87	122
1959	47	10	105	89	63	11	98	106
1960	25	4	38	67	36	24	58	87
4-yar avg.	32	22	55	71	48	42	81	101

Table 3.—Nitrogen loss from a Sharkey clay soil as influenced by nitrogen placement on the soil surface vs drilled about 4 inches deep. (Nitrogen sources averaged).

	10-Day period				20-Day period			
	Not water-logged		Water-logged		Not water-logged		Water logged	
Year	Surface	Drilled	Surface	Drilled	Surface	Drilled	Surface	Drilled
	Lbs./A of ammonium plus nitrate nitrogen lost							
1957	17	4	39	26	69	33	99	71
1958	79	31	96	40	80	41	109	100
1959	29	28	96	97	38	36	111	92
1960	41	0	97	7	61	0	117	29
4-year avg.	42	16	82	43	62	28	109	73

sodium nitrate as compared to ammonium sulfate. This variation in loss, between years from sodium nitrate was influenced by rainfall. The greatest loss occurred during the years with the highest rainfall.

When the soil was kept water-logged for 10 to 20 days, considerably more nitrogen was lost from sodium nitrate than from ammonium sulfate. When the soil was water-logged for 10 days the nitrogen loss from ammonium sulfate was 55 pounds of N per acre compared to 71 pounds from sodium nitrate. After 20 days the nitrogen loss from ammonium sulfate and sodium nitrate was 81 and 101 pounds per acre, respectively.

Nitrogen loss as influenced by placement of nitrogen on the soil surface vs an application drilled about 4 inches deep is shown in Table 3.

Nitrogen loss each year was greater from the surface than from the drilled application regardless of the water-logged condition of the soil.

The 4-year average nitrogen loss from the non-water-logged soil was 42 pounds of N per acre when the nitrogen was surface applied and 16 pounds when drilled. After 20 days the nitrogen loss for the surface and drilled application was 62 and 28 pound of N per acre, respectively.

When the soil was maintained under a water-logged condition for 10 days the 4-year average nitrogen loss was 82 pounds of N per acre from the surface applied nitrogen and 43 pounds from the drilled application.

Where the soil was water-logged for 20 days the average nitrogen loss from the surface applied nitrogen was 109 pounds of N per acre compared to 73 pounds from the drilled application.

The amount of nitrogen lost was greater from the surface than from the 4-inch depth of application regardless of water-logged treatments and nitrogen sources as shown in Table 4.

Where the soil was not water-logged, except by rain, more nitrogen was lost from surface applied ammonium sulfate than from sodium nitrate applied in the same manner. The reason for the greater nitrogen loss from surface applied ammonium sulfate than from similarly applied sodium nitrate can not be explained. However, some ammonium fixation by this soil could have occurred when the soil surface dried after each rainfall. Some loss as ammonia may have occurred through volitilization of surface applied ammonium sulfate. After a 10-day period the nitrogen loss was about equal for ammonium sulfate and sodium nitrate applied 4 inches under the soil surface. At the end of 20 days the nitrogen loss from sodium nitrate was about twice that from ammonium sulfate when both nitrogen sources were applied 4 inches under the soil surface.

When the soil was maintained in a water-logged condition for periods of either 10 and/or 20 days the nitrogen loss from sodium nitrate was greater than from ammonium sulfate regardless of the method of placement.

Under field conditions most of the nitrogen loss in the clay soils will occur from the time of nitrogen applications or from about April 1 until July 1. Anytime during this 3-month period, the quantity and distribution of rain may be sufficient to keep clay soils water-logged for extensive periods. If rainfall does water-log these clay soils, the amount of applied nitrogen that is lost through denitrification will be proportional to the length of time that the soil is water-logged and the temperature. As the mean temperature increases, nitrogen loss from the water-logged soil also increases. Most of the nitrogen losses may occur rapidly during 1 or 2 extensive wet periods and/or gradually during several shorter wet periods. Generally, the nitrogen losses increase with an increase in total rainfall and an increase in mean temperature.

At present there are no direct measures to avoid loss of nitrogen through denitrification in water-logged clay soils. The loss can be reduced by proper nitrogen placement. The nitrogen should be applied under the soil surface about 4-8 inches deep. As a preventive measure, it is suggested that farmers apply nitrogen to these clay soils in a split application. Approximately 50-60 pounds of nitrogen could be applied at planting and 50-60 pounds as an early side-dressing after the cotton has been thinned. There is no assurance that the nitrogen applied as a split-application will not be lost but the interval during which losses may occur is reduced by this method of application. Nitrogen deficiency symptoms of plants growing in these soils, between the time of the side-dress application and early plant maturity indicate that the nitrogen has been lost. Additional nitrogen may be applied to cotton to correct this deficiency but should not be applied later than mid-July.

Table 4.—Nitrogen loss from a Sharkey clay soil as influenced by water-logged treatments, 2 nitrogen sources, and 2 methods of nitrogen placement. (4-year average).

	10-Day period		20-Day period	
Nitrogen source and placement	Not-water-logged	Water-logged	Not-water logged	Water-logged
Ammonium sulfate-surface	52	78	77	100
Ammonium sulfate-drilled 4"	12	31	19	64
Sodium nitrate-surface	31	86	48	118
Sodium nitrate-drilled 4"	14	55	36	83

BULLETIN 669 July 1963

The Economics of

Supplemental Irrigation In Cotton

Yazoo-Mississippi Delta

By FRED T. COOKE, JR.

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Economic Research Service
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THE ECONOMICS OF SUPPLEMENTAL IRRIGATION IN COTTON — YAZOO-MISSISSIPPI DELTA

By FRED T. COOKE, JR.

Because the Delta receives an average annual rainfall of more than 50 inches the irrigation of row crops in this area has been insignificant until recent years. The recent interest in this practice has been brought about by several factors. Among the more important are: (1) the relatively widespread drought conditions which existed in humid areas during critical growing periods for the last few years; (2) the generally improved capital position of farmers since World War II, which creates a favorable environment for venturing into the new and untried; (3) the generally favorable reports which have come from experience with the practice; (4) technological improvements in irrigation equipment; and (5) continued efforts on the part of producers to maintain total production on a restricted land base.

Drought conditions that occurred during the years 1952 through 1956 did much to encourage the use of supplemental irrigation. Irrigation was used in Mississippi on more than 150 thousand acres in 1954, the year when use of the practice reached its peak. In the Delta 62 thousand acres of cotton were irrigated in 1960.

Because irrigation is a relatively new practice an evaluation of its economic feasibility is badly needed.

OBJECTIVES

The overall objective of this study was to develop economic information useful to farmers in Mississippi in making decisions relative to the use of supplemental irrigation. More specifically the objectives are: (1) to determine the investment and operating costs for developing and using irrigation water from alternative sources; (2) to determine the investment needs, operating costs, and labor requirements for alternative methods of distributing irrigation water; (3) to provide a costs and returns evaluation of supplemental irrigation; (4) to appraise how supplemental irrigation fits into existing farming systems and its effect on farm organization and farm income; and (5) to appraise the potential influence of supplemental irrigation on the agricultural economy.

PROCEDURE

Information pertaining to development costs, labor used, practices, and yields from irrigated and nonirrigated cotton fields which were similar with respect to soil resources, varieties, planting dates, fertilization, and all practices other than irrigation was obtained from a sample survey of 100 farmers who irrigated cotton in 1957 and 90 farmers who irrigated cotton in 1960.

These data were supplemented with intensive field studies of labor requirements for different distribution systems. The labor used for each individual operation was timed, and these data were used to determine per acre labor requirements for each of the major systems. Two systems, plastic gated pipe and contour border check, are not included in this study because their use was extremely limited.

To determine the yield response of cotton to irrigation a "paired field" tech-

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[1] Agricultural Economist, Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, stationed at the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Miss.

nique was used. These tests were conducted on about 30 farms for 4 consecutive years. However, only 47 of these tests provide usable information pertaining to yields because some farmers failed to keep the crop separated by fields at harvest time.

Two soil types were included. One is referred to as sandy soils and one as loam soils. The sandy soils are actually fine sandy loams, very fine sandy loams, and silty loams. The loam soils are silty clay loams.

The weather pattern for the year was divided into two seasons. Rainfall in July and August was used to determine the need for irrigation, and rainfall in September and October was studied to determine the maturing and early harvest conditions for irrigated cotton. Weather groupings were made for five specific types of situations. (1) The first situation reflects no need for irrigation. (2) In some years irrigation was used, but rainfall immediately following irrigation nullified most of the effectiveness of the irrigation. This type of year is referred to as a "no response year." (3) When irrigation use was scant and some response was obtained the year is referred to as a "moderately dry year." (4) When prolonged drought occurred, indicating the need for heavy water use, and the maturing season in September and October was also dry, this situation is referred to as a "dry year." (5) In some years irrigation was used extensively, but heavy rains in September and October seriously reduced yields from irrigated cotton. Such years are termed "dry-wet years" in this study.

To determine the frequency with which these years might occur in the Mississippi Delta, rainfall data for July, August, September and October were analyzed for the 46 years of weather records at Stoneville, Miss. Each year was classified as one of the five types discussed above. These classifications represent value judgments of researchers and are not hard and fast. However, it appears that they are accurate enough to serve as guides to evaluate irrigation in the area.

COSTS OF IRRIGATING COTTON

Costs involved in irrigation fall into three broad categories, namely; (1) development costs, (2) annual operating costs, and (3) other practices and costs associated with irrigation.

Development costs vary considerably and are directly related to the type of distribution system used. The three most prevalent distribution systems in the Delta are considered in this analysis. These are (a) sprinkler systems, (b) gated pipe systems, and (c) syphon tube systems.

Annual operating costs also vary widely among these systems, particularly with respect to water and labor costs.

In addition to investment and operating costs, there are certain other costs associated with the use of irrigation. These costs include items such as added weed-control measures and different insect-control practices.

Development Costs

Development costs for the three distribution systems are presented in table 1

Most of the farmers included in this study obtained irrigation water from wells equipped with electric-powered motors. Only this source of water will be considered in the analyses. Most of the data pertaining to investment costs associated with irrigation were obtained from a previous study.[2]

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[2] "Investment and Operating Costs of Irrigation in the Delta Area of Mississippi," by Thomas E Tramel, Grady B. Crowe, and J. F. Abel, Jr., Miss. Agr. Expt. Sta. Bul. 559, May 1958.

Most of the farms in the sample had considerable investment in permanent conveyance structures, such as ditches and flumes, to carry the water from the well to the fields to be irrigated. Farms where sprinkler systems were used had 1.15 miles of permanent conveyance structures, farms with gated pipe systems had 1.25 miles, and farms with syphon tube systems had 2.25 miles.

Many of these structures were considerably larger than necessary. Therefore, the average cost of these structures ($225 per mile) was somewhat higher than necessary.

The investment figures for pipe and other equipment for each of the systems are the averages for the number of farmers reporting each type system.

Some land forming was reported on slightly over one-half the farms using gated pipe and syphon tube systems. The investment figure included in table 1 for land forming is the average per farm reporting use of the practice. In general, it may not be accurate to charge all the costs of land forming to irrigation, since it can be expected to result in improved drainage and more timely performance of field operations. However, for the purposes of this study all of this cost has been charged to irrigation.

The cost of land lost to conveyance structures was obtained from a previous study.[3] Interest on the total investment was charged at 6 percent per annum.

The depreciation charges are based on a 20-year length of life. Most of this equipment has a length of life of from 12 to 14 years, but would not be used in years in which there was no irrigation. This lack of use, plus high repair costs, would add to its length of life.

Table 1 indicates an annual overhead cost per acre of cotton subject to irrigation of $7.91 for sprinkler systems, $7.01 for gated pipe, and $3.69 for syphon tube systems. It must be remembered that most syphon tube systems are found on farms where the natural contour of the land irrigated was such that little or no land forming was needed. Most farmers who use sprinkler or gated pipe systems use them because they would have to do

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[3] Ibid.

Table 1.—Estimated initial investment and annual fixed cost by types of irrigation systems, Delta Area of Mississippi.

Item	Irrigation systems Sprinkler	 Gated pipe	 Syphon tube
	Dollars	Dollars	Dollars
		Average per farm	
Investment:[1]			
Wells, pumps, and power units	3,982	3,505	3,194
Other pumps and power units	2,155	1,308	760
Trailers	81	68	38
Pipes	3,684	3,696	456
Other equipment	1,366	305	150
Land forming	--- ----	1,747	1,667
Conveyance structures[2]	780	771	1,290
Total	12,048	11,400	7,555
		Average per acre irrigated	
Total investment:	73.91	65.52	36.32
Annual fixed costs:			
Interest on investment	4.43	3.93	2.18
Depreciation	3.48	3.08	1.51
Total	7.91	7.01	3.69

[1] Adapted from data contained in "Investment and Operating Costs of Irrigation in the Delta Area of Mississippi," by Thomas E. Tramel, Grady B. Crowe, and J. F. Abel, Jr., Miss. Agr. Expt. Sta. Bul. 559, May 1958.

[2] Including value of land occupied.

extensive land forming before the syphon tube system could be used.

These differences in overhead costs among systems are very important because these costs must be charged every year even though no irrigation is performed in some years.

Annual Operating Costs

Annual operating costs for the various systems include cost of pumping water, maintanance of permanent conveyance structures, construction and leveling of temporary ditches and flumes, labor costs, and repairs to irrigation equipment. These costs are presented in table 2.

The cost of pumping water from wells of the size most commonly reported in this study, 800 to 1,500 gallons per minute, is estimated to be $0.42 per acre-inch of water pumped[4]. The cost of relifting water for gated pipe systems was found to be $0.66 per acre-inch[5], and for sprinkler systems $0.75 per acre-inch. It should be noted that water cost for one irrigation with gated pipe is somewhat higher than for sprinklers because 4 inches of water is applied by gated pipe in one irrigation and only 3 inches with a sprinkler system. Sprinkler systems are usually of smaller capacity than gated pipe and it is necessary to move them more frequently.

Some temporary flumes and ditches were used with all types of systems, and the average per farm was found to be 0.55 miles with sprinkler systems, 0.90 miles with gated pipe systems, and 1.73 miles with syphon tube systems. These structures cost $67.32 per mile to build and level after use.

Maintenance of permanent ditches and flumes is usually performed only in years in which irrigation is used. The average cost of maintaining a mile of permanent ditch was $46.73. This includes cleaning weeds out of the ditch and repairs to the banks when needed.

The tendency to replace permanent conveyance structures with temporary ones has been marked in the last few years. This is due to several factors. Many of the permanent structures were too large and poorly engineered. They took up excessive amounts of land and interfered with equipment operation. Temporary structures can often be placed on turn rows with no additional loss of land. Temporary structures are not present to interfere with machinery most of the time. One of the most important advantages of temporary flumes is that they are built and leveled annually therefore they do not provide a source of in-

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[4] Ibid.

[5] "Water Loss in Irrigation Channels in the Yazoo-Mississippi Delta," by Fred T. Cooke, Jr., Miss. Agr. Expt. Sta. Bul. 626, July 1961.

Table 2.—Annual operating costs per acre, per irrigation, for sprinkler, gated pipe, and syphon tube systems, Delta Area of Mississippi[1].

	Cost per irrigation		
Item	Sprinkler	Gated pipe	Syphon tube
	Dollars	Dollars	Dollars
Pumping cost[2]	3.51	4.32	1.68
Permanent conveyance maintenance	.15	.13	.33
Temporary ditches and flumes	.10	.14	.23
Labor	1.70	1.50	1.04
Repairs and miscellaneous costs	.61	.49	.16
Total operating costs	6.07[3]	6.58[3]	3.44[3]

[1] The once-over equivalent use for these systems was sprinkler — 372 acres, gated pipe — 447 acres, and syphon tube — 507 acres.

[2] 42c per acre-inch pumping cost at well; 66c per acre-inch relift pumping cost for gated pipe: 75c per acre-inch relift pumping cost for sprinklers.

[3] 4 acre-inches of water applied with gated pipe and syphon tubes and 3 acre-inches with sprinklers

creased weed infestation. This is a major problem with permanent ditches.

Intensive study was given to labor use for the three systems included in this analysis. Forty-eight field observations of labor use associated with sprinkler systems was made over a 4-year period. These data were combined with information obtained from schedules taken in 1957 and 1960. It was found that labor used averaged 4.25 man-hours per acre and, in general, ranged from 3.5 man-hours to 5 man-hours per acre for one irrigation.

Most of the laborers involved in moving sprinklers from one setup to another were temporarily transferred from other farming operations. When the move was completed the labor returned to its former task.

Sprinkler systems have two features which make them difficult to operate. The presence of mud and rank growth of the cotton plant impedes the movement of pipe from one setup to the next. This problem causes farm laborers to be reluctant to work with sprinkler systems. The investment per acre irrigated is high with sprinkler systems. Sprinkler systems are usually found where the topography is uneven and farmers feel the cost of land forming will be excessive.

Fifty-two field observations of labor use associated with gated pipe systems were made in the 4 years of study. These data were combined with data taken from the schedules, and it was found that it required an average of 3.75 hours of man labor to irrigate one acre of cotton one time over. These requirements ranged from a low of 3 man-hours to a high of 6.5 man-hours per acre.

As with the sprinkler systems, labor was temporarily taken from other tasks to move the gated pipe systems. There were usually one or two men, depending on the size of the system, left in attendance with the gated pipe systems to do necessary shovel work to keep the water moving down the row. This was especially true on fields which had not been formed to a certain grade.

The use of gated pipe does not usually result in problems with mud and rank growth as is the case with sprinklers and fewer ditches are needed than with syphon tube systems. The main drawback associated with the gated pipe system is its high initial investment cost per acre. The topography of the land must be of fairly uniform slope or the land formed before this system can be used effectively.

Forty-six field observations of the labor use associated with syphon tube systems were made during the period of this study. When these data were combined with that from the surveys it indicated that 2.6 man-hours of labor was required to irrigate one acre of cotton one time over. These requirements ranged from a high of 4.1 man-hours to a low of 1.25 man-hours per acre.

Labor was used from other jobs on the farm for the initial setup on syphon tube systems, but once this setup was made and flumes stabilized attendance of the system, and movement of the syphon tubes was usually handled by two men.

Syphon tube systems require favorable topography in fields irrigated, or land forming must be done if they are to be used efficiently. Some land is lost with these systems, but it is not significant if head ditches and flumes are established on turn rows. Syphon tube systems have the advantage of low investment costs per acre irrigated coupled with low operating costs. This system also makes it possible to irrigate a maximum amount of land in a limited time. This factor is important where the timing of water application is critical.

It was apparent in this study that sprinkler systems were being abandoned in favor of gated pipe and syphon tube systems, particularly where land forming was feasible. Realization that other benefits accrue to land forming has resulted in increased use of this practice. Some farmers, who do not feel that they can afford to form land, have abandoned any form of irrigation rather than use sprinkler systems. This has been due to the fact that they feel the total cost of owning and operating these systems is more than the return they can expect from irrigation. Also, the difficulty in handling and moving sprinkler systems has resulted in the loss of some of the permanent labor force.

It was noted throughout the study that relatively unskilled farm labor such as hoe hands or young boys, furnished the bulk of the irrigation labor. For this reason wage rates for irrigation labor were comparatively low, amounting to $0.40 per hour.

The estimated annual operating costs per acre, per irrigation for the three systems are $6.07 for sprinklers, $6.58 for gated pipe, and $3.44 for syphon tube systems, table 2. Costs with gated pipe are more than sprinkler systems largly because more water is usually applied per irrigation by farmers who use gated pipe systems. If 3 rather than 4 inches of water were applied by gated pipe and syphon tube systems, the estimated operating cost per acre per application would be $5.50 and $3.02, respectively, for these methods.

Associated Costs

In addition to the direct costs of irrigation there are modifications in other production practices which tend to increase production costs per acre. Practices affected most are weed control and insect control.

Because of the condition of the soil after water is applied irrigated cotton is cultivated less frequently than non-irrigated cotton. Results of this study indicate that cultivations for the season are reduced by one. On the other hand, irrigation tends to intensify weed infestation and more chopping labor was needed for weed control. The net increase in costs for this item amounted to $3.75 per acre (table 3.)

Because irrigation usually lengthens the growing and fruiting period in cotton and because usual weed control practices cannot be employed it has become a common practice to treat irrigated fields with "lay-by" chemicals.[6] On cotton not irrigated only about half the acreage is treated with this chemical. This results in a net cost per acre to irrigation for this item of $4.00 on sandy soils and $6.00 on loam soils.

For the 4 years in which this study was conducted the use of irrigation did not result in an increase in the number of applications of insecticides. Other studies, over different time periods, have shown that irrigation intensified the insect problem and that additional applications of insecticides were necessary. Especially, is this true in years when the incidence of drought induces irrigation through August and September. In such situations irrigated cotton continues to fruit and the plants remain green

Table 3.—Per acre increases in preharvest cotton production costs associated with irrigation on sandy and loam soils, Delta Area of Mississippi.

Item	Soil	
	Sandy	Loam
	Dollars	Dollars
Insecticide application	0.90	0.90
Lay-by herbicide	4.00	6.00
Labor for weed control	3.75	3.75
Total	8.65	10.65

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[6] This is the practice of treating cotton fields with chemical herbicides after the last cultivation.

and succulent whereas nonirrigated cotton matures rapidly. In these instances, the fruit set in irrigated cotton must be protected from insects over a longer period of time. Partial economic evaluations of irrigation in 1954 and 1956 indicated that irrigated cotton required 3 more applications of insecticides than nonirrigated.[7]

However, this study did indicate that the use of irrigation required the shifting of two applications of insecticides from ground machines to planes resulting in a net increase in cost of $0.90 per acre.

Ordinarily, the use of irrigation could be expected to result in increased inputs of fertilizer. However, fertilizer application in the Delta is a preplant operation and at this time the operator does not know whether he will irrigate or not. In addition, cotton producers feel that high fertilization and irrigation lengthens the growing period to such an extent that they run a high risk of encountering unfavorable harvesting weather which could cause reductions in yield. For these reasons, fertilizer inputs on irrigated cotton are not much different from those on cotton not irrigated.

Table 3 summarizes the increases in cotton production costs associated with irrigation.

Total Costs of Irrigation

Total cost of irrigation then is derived from these three components, (1) annual overhead costs, (2) annual operating costs, and (3) costs associated with irrigation.

Annual overhead costs apply to each acre subject to irrigation and must be charged regardless of whether the irrigation system is used or not.

Annual operating costs are chargeable only during seasons when irrigation is used and are directly related to the number of water applications.

Associated costs of irrigation are applicable only when irrigation is practiced, but they are found to be relatively constant regardless of the number of irrigations applied.

In table 4 are presented the estimated costs of irrigating one acre of cotton on sandy soils one, two, and three times with each of the three systems of water distribution reported on in this study.

Irrigation costs for sprinkler and gated pipe systems are about the same. The use of syphon tubes, however, is consider-

Table 4.—Cost of irrigating one acre of cotton; one, two, and three times, and yield increases necessary to cover these costs by irrigation systems, sandy soils, Delta Area of Mississippi.

	Sprinkler			Gated pipe			Syphon tube		
	Number irrigations			Number irrigations			Number irrigations		
Item	One	Two	Three	One	Two	Three	One	Two	Three
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Annual overhead costs	7.91	7.91	7.91	7.01	7.01	7.01	3.69	3.69	3.69
Annual operating costs	6.07	12.14	18.21	6.58	13.16	19.74	3.44	6.88	10.32
Associated costs	8.65	8.65	8.65	8.65	8.65	8.65	8.65	8.65	8.65
Total costs	22.63	28.70	34.77	22.24	28.82	35.40	15.78	19.22	22.66
Pounds of seed cotton necessary to pay for irrigation[1]	178	219	265	169	220	272	121	148	179

[1] Prices of 32.39 cents per pound of lint and $50.00 per ton of seed were used in making these calculations.

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[7] "Investment and Operating Costs of Irrigation in the Delta Area of Mississippi," by Thomas E. Tramel, Grady B. Crowe, and J. F. Abel, Jr., Miss. Agr. Expt. Sta. Bul. 559, May 1958.

Table 5.—Cost of irrigating one acre of cotton; one, two, and three times, and yield increases necessary to cover these costs, by irrigation system, loam soils, Delta Area of Mississippi.

	Sprinkler			Gated pipe			Syphon tube		
	Number irrigations			Number irrigations			Number irrigations		
Item	One	Two	Three	One	Two	Three	One	Two	Three
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Annual overhead costs	7.91	7.91	7.91	7.01	7.01	7.01	3.69	3.69	3.69
Annual operating costs	6.07	12.14	18.21	6.58	13.16	19.74	3.44	6.88	10.32
Associated costs	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65	10.65
Total costs	24.63	30.70	36.77	24.24	30.82	37.40	17.78	21.22	24.66
Pounds of seed Cotton necessary to pay for irrigation[1]	187	238	281	184	237	287	136	163	191

[1] Prices of 32.39 cents per pound of lint and $50.00 per ton of seed were used in making these calculations.

ably cheaper than either of the other two methods.

Also shown in table 4 are the yield increases, expressed in pounds of seed cotton, necessary to cover total costs of irrigation. These increases range from a low of 121 pounds for one irrigation with syphon tubes to 265 pounds for three irrigations with sprinklers.

Table 5 presents the same information for loam soils in the Delta. Irrigation costs are slightly higher on loam soils than for sandy soils because of the higher rates of chemical herbicides necessary.

YIELD RESPONSE TO IRRIGATION

The purpose of irrigation is to supply moisture to crops during periods of drought. When a farmer irrigates his cotton crop, he is hoping to increase yield sufficiently to pay the costs of irrigation and receive some additional returns above these costs. Experience in the Delta has shown that the possibility of increasing yields and the amount of these increases is dependent on the weather immediately following irrigation and the kind of weather occurring during the maturing and harvesting seasons in September and October.

Tests were set up with cooperating farmers to determine the yield differences between irrigated and nonirrigated cotton under farm conditions. Fields chosen were as near as possible the same with respect to soil types, planting dates, fertilization rates, and varieties of cotton. The tests were conducted every year from 1957 through 1960. This information was supplemented with data obtained from irrigation response studies conducted at the Delta Branch Experiment Station at Stoneville, Miss. Twenty-nine tests were completed for paired fields on sandy soils and 18 on loam soils.

Results of this study indicate that individual crop seasons can be grouped in five categories or types based on rainfall and growing and harvesting conditions. One of these types reflects adequate moisture throughout the growing season and **no irrigation** is needed.

No Response Years

In some years, short droughts prompt the use of irrigation but during or immediately following an irrigation, rainfall occurs. Field tests indicate that these rains reduce or cancel the effects of irrigation.

Under these conditions the average yield on sandy soils not irrigated was 600 pounds of lint per acre, fields receiving irrigation had average yields of 610 pounds of lint per acre. The yield on loam soils was 530 pounds of lint on both irrigated and nonirrigated fields. The small increase on sandy soils may have been due to the fact that irrigation provided moisture at a critical time. Loam soils generally have a higher moisture holding capacity and timing of the application of water is not as critical as for sandy soils.

Moderately Dry Years

This type year usually occurs when drought conditions arise rather late in the growing season, after August 1, and one or two irrigations are performed. This is followed by a normal amount of rain, 2 to 4 inches, during September and early October. There is some loss of potential yield from boll rot and delayed maturity, but this is not usually very serious.

The average yield on sandy soils which were irrigated in this type year was 700 pounds of lint per acre. The average yield from nonirrigated fields of the same type was 610 pounds of lint per acre. The yields from loam soils were 650 pounds of lint per acre on irrigated fields and 550 pounds of lint per acre on nonirrigated fields. It should be pointed out that on several fields yield increases of over 250 pounds of lint were obtained in this type year. On some farms with the same rainfall pattern yields were increased only 25 to 50 pounds.

Dry Years

Dry years, as would be expected, offer the greatest potential for the use of irrigation. The periods of drought is prolonged and is followed by a dry September and October. The dry September and October provides the most favorable conditions for maturity and harvest of the crop. Such a season is similar to conditions in more arid areas.

The average yield on sandy soils which were irrigated in this type year was 750 pounds of lint per acre. The average nonirrigated yield was 510 pounds of lint. Some individuals have reported yield increases of as much as 500 to 600 pounds of lint per acre in a dry year. The irrigated yields on loam soils in dry years averaged 710 pounds and the nonirrigated yield averaged 510 pounds of lint per acre.

The very dry years of 1954 and 1956 were largely responsible for the increase of irrigation in the Mississippi Delta. It was quite common in those years to hear farmers say that they increased yields of cotton enough to pay the entire cost of an irrigation system.

Dry-Wet Years

This type year is the least favorable for irrigation. A drought of fairly long duration occurs and farmers irrigate their cotton regularly. Heavy rains in September delay maturity and induce severe boll rot. Yields and quality suffer. Average yields on sandy soils in dry-wet years were 456 pounds of lint per acre with irrigation and 562 pounds on nonirrigated fields. Yields from loam soils were 430 pounds of lint per acre on irrigated fields and 505 pounds of lint per acre on nonirrigated fields.

A dry-wet year usually brings heavy losses to the cotton farmer who uses irrigation. In the paired field study yields were reduced as much as 200 pounds of lint per acre in several instances. Only a few farmers increased yields, and these increases were small.

There are other combinations of rainfall during the growing and maturing seasons which could affect yields of irrigated cotton. However, it is believed that most years will fit fairly well into one of the five types of years discussed.

It should be pointed out that daily rainfall records were kept on each farm where paired field tests were established. If the rainfall on a particular farm differed significantly from the common rainfall pattern in the area, the results obtained from this farm were combined with another year which more nearly fit the situation on that particular farm.

RETURNS TO IRRIGATED COTTON

Returns to irrigation are determined by the cost of irrigation and the difference in yields, if any, due to irrigation. It has been shown that rainfall during and following the growing season materially affects the production cost and yields of irrigated cotton in any given year.

Yield increases do not tell the complete story of irrigation returns. The true test of the profitableness of irrigation is whether the per acre returns to irrigated cotton were greater than the per acre returns to dryland cotton. Appendix tables 1 through 8 present gross income and specified production costs (excluding irrigation costs) per acre for irrigated and dryland cotton on sandy and loam soils for each type irrigation year considered.

Appendix tables 9 through 16 show costs and returns on irrigated and dryland cotton, by type of irrigation system used on sandy and loam soils for each irrigation situation under study.

From these two sets of tables the returns to each type irrigation system for each type year discussed were obtained. These returns and the returns due to irrigation are presented for sandy soils in table 6 and for loam soils in table 7. Returns to irrigation is the difference in returns between the irrigated and dryland cotton for each type year.

Years With No Irrigation

Returns to irrigation for years in which no irrigation is used are always negative. The reduction in returns for this year is equal to the overhead costs of the irrigation system. Even though no irrigation is used this overhead cost must be included in the cost of production for those acres subject to irrigation.

Years Which Show No Response To Irrigation

It is obvious that for years in which irrigation is used but no significant increase in yields result, dryland cotton will show a higher return than irrigated. Losses in these situations ranged from $13.14 per acre on sandy soils irrigated with syphon tubes to $19.99 per acre on sandy soils irrigated with sprinklers, table 6. The loam soils losses ranged from $16.50 per acre where syphon tubes were used to $23.35 where sprinkler systems were used, table 7.

Moderately Dry Years

Returns to irrigation in this type situation were negative for sprinkler and gated pipe systems. Due to lower costs of irrigation a return of $7.99 per acre on sandy soils and $9.59 per acre on loam soils was realized by farmers who used syphon tube systems. It should be noted again that many farmers increased their yields considerably more than the average yield reported. These farmers probably received a fair return to irrigation regardless of the type systems they used.

Dry Years

Regardless of the type system used or the irrigation skill of the individual farmer, yields and profits were increased in the very dry years. The greatest returns were to syphon tube systems because of the lower costs involved in using this system.

Dry-Wet Years

In years of this type yields of cotton are usually actually reduced by irrigation. This reduction in yield, added to the cost of irrigation, reduces returns to irrigation to a loss. Returns to land, management, and overhead are also low. They ranged from $2.32 per acre where sprinklers were used to $13.55 for syphon tube systems. It should be remembered, however, that a few farmers made somewhat better yields than the average. These few farmers made yield increases more on the order of the average for

Table 6.—Per acre returns to land and management and to irrigation, by irrigation system and type of production year for irrigated and dryland cotton, sandy soils, Delta Area of Mississippi.

Type of year	Irrigation system						
	Sprinkler		Gated pipe		Syphon tube		Dryland
	Net returns[1]	Returns to irrigation	Net returns[1]	Returns to irrigation	Net returns[1]	Returns to irrigation	Net returns[1]
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
No irrigation	64.95	− 7.91	65.85	− 7.01	69.17	− 3.69	72.86
No response	52.87	−19.99	53.26	−19.60	59.72	−13.14	72.86
Moderately dry	70.29	− 4.71	73.10	− 1.90	82.99	7.99	75.00
Dry	81.87	35.15	84.43	37.71	96.04	49.32	46.72
Dry-Wet	2.32	−59.51	5.37	−56.46	13.55	−48.28	61.83

[1] Returns to land, management, and overhead.
Minus denotes loss.

Table 7.—Per acre returns to land and management and to irrigation, by irrigation system and type of production year for irrigated and dryland cotton, loam soils, Delta Area of Mississippi.

Type of year	Irrigation system						
	Sprinkler		Gated pipe		Syphon tube		Dryland
	Net returns[1]	Returns to irrigation	Net returns[1]	Returns to irrigation	Net returns[1]	Returns to irrigation	Net returns[1]
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
No irrigation	52.27	− 7.91	53.17	− 7.01	56.49	− 3.69	60.18
No response	36.83	−23.35	37.22	−22.96	43.68	−16.50	60.18
Moderately dry	62.96	− 3.11	65.77	− 0.30	75.66	9.59	66.07
Dry	67.17	12.73	69.73	15.29	81.34	26.90	54.44
Dry-Wet	5.70	−46.65	8.75	−43.60	16.93	−35.42	52.35

[1] Returns to land, management, and overhead.
Minus denotes loss.

moderately dry years, 90 pounds per acre on sandy soils and 100 pounds per acre on loam soils. For these farmers losses due to irrigation were sharply reduced.

This analysis indicates that the profitableness of irrigation in the Mississippi Delta is contingent on weather conditions during the growing and maturing seasons—conditions which show marked variations from year to year.

WEATHER PROBABILITIES AND RETURNS TO IRRIGATION

To make a wise decision as to whether or not to invest in an irrigation system the cotton producer must have some idea of the frequency with which the various types of years will occur. An effort was made to determine this by analyzing the weather records at Stoneville for the last 46 years. The amount of rainfall which fell for each 15-day period in July and August was recorded. From these data the need for irrigation was approximated. The determination of the weather during the maturing and harvesting season was made from rainfall records in September and October. Using these data each of the 46 years for which rainfall records were available were classified into one of the five type situations previously discussed.

These groupings represent the considered judgment of personnel conducting

Table 8.—Effect of irrigation on per acre returns to cotton, by type of irrigation system, by soil type, and by type of irrigation situation, 46-year total, Delta Area of Mississippi.

Irrigation	Irrigation situation[1]						Weighted
system and soil	No irrigation	No reponse	Moderately dry	Dry	Dry-wet	46-year total	average per year
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Sprinkler							
Sandy	—79.10	—119.94	— 75.36	421.80	—119.02	28.38	0.62
Loam	—79.10	—140.10	— 49.76	152.76	— 93.30	—209.50	— 4.55
Gated pipe							
Sandy	—70.10	—117.60	— 30.40	452.52	—112.92	121.50	2.64
Loam	—70.10	—137.76	— 4.80	183.48	— 87.20	—116.38	— 2.53
Syphon tube							
Sandy	—36.90	— 78.84	127.84	591.84	— 96.56	507.38	11.03
Loam	—36.90	— 99.00	153.44	322.80	— 68.84	271.50	5.90

[1] The distribution of years according to irrigation situations is as follows: no irrigation 10 years; no response 6 years; moderately dry 16 years; dry 12 years; and dry-wet 2 years.

irrigation research and are the most sophisticated estimates available at this time.

Table 8 shows the number of years of occurrence of each type irrigation year from 1915 through 1961 and the average yearly returns to each soil type and irrigation system for the 46-year period. From this table it is obvious that over the long run, irrigation on cotton would have been profitable only with syphon tube systems, or gated pipe systems on sandy soils. When an average investment of $65.52 per acre for gated pipe systems is taken into account, the return to the investment is only 4 percent. Even though sprinkler systems on sandy soils show a small profit it is too little to justify irrigating cotton with sprinklers. The syphon tube system returned 30.4 percent to investment in irrigation equipment on sandy soils and 16.2 percent on loam soils. This represents a good return, but it must be indicated that most syphon tube systems are used on fields where little or no land forming was needed. This factor tends to reduce the per acre investment for this type of system. However, if land forming is done on more acreage in the future, it is doubtful that a large portion of the forming cost should be charged to irrigation. As the benefits to drainage, machinery utilization, and effective chemical application are sizeable, these items should bear a portion of the land forming costs.

CONCLUSIONS

Results of this study show that syphon tube systems are the cheapest method of irrigation for the Mississippi Delta. The high per acre cost for sprinkler and gated pipe systems is because only a limited number of acres can be handled with these systems. The cost of pipe to transport water to irrigated fields is much higher than the cost of a ditch or flume. The necessity of relifting water for these two systems more than doubles the pumping cost of water used. It is not always necessary to relift water with a gated pipe system, but in most cases it is done in this area. Better planning and engineering could eliminate much of this cost

Labor costs for syphon tube systems are much less than for the other two systems because no pipe has to be moved and because large acreages can be irrigated with one set-up of the system. It must be emphasized that most syphon tube systems are used on fields which require little or no land forming. Cost of forming fields for irrigation with this type system should not be prohibitive in most cases since only a portion of this cost should be charged to irrigation.

The associated production costs which are brought about by irrigation are not affected materially by the type distribution system used. Head ditches and flumes used with syphon tubes can interfere with equipment operation, but this usually presents no great problem. The shift from ground machine application to plane application of insecticides is necessary with all irrigation systems.

Most farmers who irrigated applied lay-by chemicals to their irrigated fields. This was done to control weeds germinated by irrigation. Lay-by chemicals are also used more often in irrigated cotton because the presence of moisture assures activation of the chemical.

Irrigated fields were usually cultivated one time less than dryland cotton because it was impossible to plow wet fields as often. One additional hoeing usually was required for weed control in most cases.

Cotton yields can be increased or decreased by irrigation, depending on how rainfall is distributed during the growing and maturing seasons. But even when yields are increased by irrigation net returns may be higher on dryland fields because the added costs of irrigation are greater than the returns from the yield increases. The type of irrigation system used has much to do with costs and net returns from irrigated cotton. It takes a much smaller increase in yield to cover the cost of irrigating an acre of cotton with a syphon tube system than with a sprinkler system. As table 8 indicates only syphon tube systems give a sizeable return to irrigation and this is partly because of little or no investment in land forming.

Some farmers consistently make higher yields from irrigation than the average. These farmers had several things in common. First and prehaps most important, they consistently made higher yields on dryland cotton than most farmers in the area. These farmers consistently produced 750 pounds of lint per acre or more on better soils. They also were irrigating some of the most productive land in the Mississippi Delta. In short, these were superior managers irrigating better soils. The farmers who were getting larger increases in yields from irrigation also did a better job of irrigating. This was particularly true of the timing of irrigations.

This study indicates that for irrigation to be profitable in the Delta area of Mississippi the average farmer must be able to use an irrigation system which has a low development cost and a low operating cost such as syphon tube systems, on fairly level fields. If this is not possible then only exceptional managers who consistently make high cotton yields should consider the practice.

The outlook for irrigation in the area should improve as more farmers become proficient at irrigating and if means could be found to offset some of the bad effects of irrigation in certain years. However, skip row planting could prove to be more profitable to most farmers than irrigation. If this practice becomes widespread it is doubtful that many more acres of cotton would be irrigated in the future.

APPENDIX

Appendix Table 1.—Gross income and specified costs, excluding irrigation costs, for sandy soils, no response year, Delta Area of Mississippi.

		Dryland			Irrigated		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	120	0.312	37.44	122	0.312	38.06
Machine picked	lb.	480	.295	141.60	488	.295	143.96
Cotton seed	lb.	1060	.025	26.50	1078	.025	26.95
Total	lb.	------	--.------	205.54	------	--.------	208.97
Expenses:							
Seed	cwt.	0.6	9.00	5.40	0.6	9.00	5.40
Fertilizer	cwt.	1.2	6.10	7.32	0.6	6.10	7.32
Insecticide	acre	1.0	11.05	11.05	1.0	11.05	11.05
Insecticide application	acre	1.0	3.00	3.00	1.0	4.50	4.50
Herbicide	acre	1.0	3.20	3.20	1.0	7.20	7.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	5.47	1.79	9.79	5.47	1.79	9.79
Equipment operation	hr.	--.--	--.----	34.92	--.--	--.----	34.32
Ginning, bagging and ties	cwt.-lint	--.--	--.----	16.20	--.--	--.----	16.47
Interest on operating capital	acre	--.--	--.----	3.86	--.--	--.----	4.14
Miscellaneous	acre	--.--	--.----	1.00	--.--	--.----	1.00
Labor — chopping and picking	--------	--.--	--.----	25.86	--.--	--.----	30.00
Other labor	--------	--.--	--.----	8.12	--.--	--.----	7.97
Total	--------	--.--	--.----	132.68	--.--	--.----	142.12

Appendix Table 2.—Gross income and specified costs excluding irrigation costs, for sandy soils, moderately dry year, Delta Area of Mississippi.

		Dryland			Irrigated		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	122	0.312	38.06	140	0.312	43.68
Machine picked	lb.	488	.295	143.96	560	.295	165.20
Cotton seed	lb.	1078	.025	26.95	1237	.025	30.93
Total	lb.	------	-------	208.97	------	---------	239.81
Expenses:							
Seed	cwt.	0.6	9.00	5.40	0.6	9.00	5.40
Fertilizer	cwt.	1.2	6.10	7.32	1.2	6.10	7.32
Insecticide	acre	1.0	11.05	11.05	1.0	11.05	11.05
Insecticide application	acre	1.0	3.00	3.00	1.0	4.50	4.50
Herbicide	acre	1.0	3.20	3.20	1.0	7.20	7.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	5.47	1.79	9.79	5.47	1.79	9.79
Equipment operation	hr.	-----	-------	34.92	-----	-------	34.32
Ginning, bagging and ties	cwt.-lint	-----	-------	16.47	-----	-------	18.90
Interest on operating capital	acre	-----	-------	3.90	-----	-------	4.28
Miscellaneous	acre	-----	-------	1.00	-----	-------	1.00
Labor — chopping and picking	--------	-----	-------	26.10	-----	-------	32.12
Other labor	--------	-----	-------	8.12	-----	-------	7.97
Total	--------	-----	-------	133.23	-----	-------	146.81

Appendix Table 3.—Gross income and specified costs excluding irrigation costs, for sandy soils, dry year, Delta Area of Mississippi.

Item	Unit	Dryland Quantity	Dryland Price	Dryland Amount	Irrigated Quantity	Irrigated Price	Irrigated Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	102	0.312	31.82	150	0.312	46.80
Machine picked	lb.	408	.295	120.36	600	.295	177.00
Cotton seed	lb.	901	.025	22.53	1324	.025	33.10
Total	lb.	......	......	174.71	......	......	256.90
Expenses:							
Seed	cwt.	0.6	9.00	5.40	0.6	9.00	5.40
Fertilizer	cwt.	1.2	6.10	7.32	1.2	6.10	7.32
Insecticide	acre	1.0	11.05	11.05	1.0	11.05	11.05
Insecticide application	acre	1.0	3.00	3.00	1.0	4.50	4.50
Herbicide	acre	1.0	3.20	3.20	1.0	7.20	7.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	5.47	1.79	9.79	5.47	1.79	9.79
Equipment operation	hr.	......	......	34.92	......	......	34.32
Ginning, bagging and ties	cwt.-lint	......	......	13.77	......	......	20.27
Interest on operating capital	acre	......	......	3.72	......	......	4.35
Miscellaneous	acre	......	......	1.00	......	......	1.00
Labor — chopping and picking	......	......	......	23.74	......	......	33.30
Other labor	......	......	......	8.12	......	......	7.97
Total	......	......	......	127.99	......	......	149.41

Appendix Table 4.—Gross income and specified costs, excluding irrigation costs, for sandy soils, dry-wet year, Delta Area of Mississippi.

		Dryland			Irrigated		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	112	0.312	34.94	91	0.312	28.39
Machine picked	lb.	450	.295	132.75	365	.295	107.67
Cotton seed	lb.	992	.025	24.80	805	.025	20.12
Total	lb.	...	...	192.49	...	...	156.18
Expenses:							
Seed	cwt.	0.6	9.00	5.40	0.6	9.00	5.40
Fertilizer	cwt.	1.2	6.10	7.32	1.2	6.10	7.32
Insecticide	acre	1.0	11.05	11.05	1.0	11.05	11.05
Insecticide application	acre	1.0	3.00	3.00	1.0	4.50	4.50
Herbicide	acre	1.0	3.20	3.20	1.0	7.20	7.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	5.47	1.79	9.79	5.47	1.79	9.79
Equipment operation	hr.	...	...	34.92	...	...	34.32
Ginning, bagging and ties	cwt.-lint	...	...	15.17	...	...	12.31
Interest on operating capital	acre	...	...	3.81	...	...	3.90
Miscellaneous	acre	...	...	1.00	...	...	1.00
Labor — chopping and picking	...	...	...	24.92	...	...	26.34
Other labor	...	...	...	8.12	...	...	7.97
Total	...	...	...	130.66	...	...	134.06

Appendix Table 5.—Gross income and specified costs, excluding irrigation costs, for loam soils, no response year, Delta Area of Mississippi.

Item	Unit	Dryland			Irrigated		
		Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	106	0.312	33.07	106	0.312	33.07
Machine picekd	lb.	424	.295	125.08	424	.295	125.08
Cotton seed	lb.	936	.025	23.40	936	.025	23.40
Total	lb.	------	------	181.55	------	------	181.55
Expenses:							
Seed	cwt.	0.65	9.00	5.85	0.65	9.00	5.85
Fertilizer	cwt.	1.0	6.10	6.10	1.0	6.10	6.10
Insecticide	acre	1.0	11.33	11.33	1.0	11.33	11.33
Insecticide application	acre	1.0	3.00	3.00	1.0	3.00	3.00
Herbicide	acre	1.0	3.20	3.20	1.0	9.20	9.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	4.86	1.79	8.70	4.86	1.79	8.70
Equipment operation	hr.	------	------	32.41	------	------	31.81
Ginning, bagging and ties	cwt.-lint	------	------	14.31	------	------	14.31
Interest on operating capital	acre	------	------	3.53	------	------	3.81
Miscellaneous	acre	------	------	1.00	------	------	1.00
Labor — chopping and picking	------	------	------	22.26	------	------	26.16
Other labor	------	------	------	6.66	------	------	6.51
Total	------	------	------	121.31	------	------	130.74

Appendix Table 6.—Gross income and specified costs, excluding irrigation costs, for loam soils, moderately dry year, Delta Area of Mississippi.

Item	Unit	Dryland			Irrigated		
		Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	110	0.312	34.32	130	0.312	40.56
Machine picked	lb.	440	.295	129.80	520	.295	153.40
Cotton seed	lb.	972	.025	24.30	1148	.025	28.70
Total	----	------	------	188.42	------	------	222.66
Expenses:							
Seed	cwt.	0.65	9.00	5.85	0.65	9.00	5.85
Fertilizer	cwt.	1.0	6.10	6.10	1.0	6.10	6.10
Insecticide	acre	1.0	11.33	11.33	1.0	11.33	11.33
Insecticide application	acre	1.0	3.00	3.00	1.0	3.00	3.00
Herbicide	acre	1.0	3.20	3.20	1.0	9.20	9.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	4.86	1.79	8.70	4.86	1.79	8.70
Equipment operation	hr.	-----	-------	32.41	-----	-------	31.81
Ginning, bagging and ties	cwt.-lint	-----	-------	14.85	-----	-------	17.55
Interest on operating capital	acre	-----	-------	3.56	-----	-------	3.99
Miscellaneous	acre	-----	-------	1.00	-----	-------	1.00
Labor — chopping and picking	-------	-----	-------	22.73	-----	-------	28.99
Other labor	-------	-----	-------	6.66	-----	-------	6.51
Total	-------	-----	-------	122.35	-----	-------	136.99

Appendix Table 7.—Gross income and specified costs, excluding irrigation costs, for loam soils, dry year, Delta Area of Mississippi.

Item	Unit	Dryland			Irrigated		
		Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	102	0.312	31.82	142	0.312	44.30
Machine picked	lb.	408	.295	120.36	568	.295	167.56
Cotton seed	lb.	901	.025	22.53	1254	.025	31.35
Total	lb.	------	------	174.71	------	------	243.21
Expenses:							
Seed	cwt.	0.65	9.00	5.85	0.65	9.00	5.85
Fertilizer	cwt.	1.0	6.10	6.10	1.0	6.10	6.10
Insecticide	acre	1.0	11.33	11.33	1.0	11.33	11.33
Insecticide application	acre	1.0	3.00	3.00	1.0	3.00	3.00
Herbicide	acre	1.0	3.20	3.20	1.0	9.20	9.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	4.86	1.79	8.70	4.86	1.79	8.70
Equipment operation	hr.	------	------	32.41	------	------	31.81
Ginning, bagging and ties	cwt.-lint	------	------	13.77	------	------	19.17
Interest on operating capital	acre	------	------	3.50	------	------	4.38
Miscellaneous	acre	------	------	1.00	------	------	1.00
Labor — chopping and picking	------	------	------	21.79	------	------	30.41
Other labor	------	------	------	6.66	------	------	16.51
Total	------	------	------	120.27	------	------	150.42

Appendix Table 8.—Gross income and specified costs, excluding irrigation costs, for loam soils, dry-wet year, Delta Area of Mississippi.

		Dryland			Irrigated		
Item	Unit	Quantity	Price	Amount	Quantity	Price	Amount
		Number	Dollars	Dollars	Number	Dollars	Dollars
Income:							
Cotton lint							
Hand picked	lb.	101	0.312	31.51	86	0.312	26.83
Machine picked	lb.	404	.295	119.18	344	.295	101.48
Cotton seed	lb.	892	.025	22.30	760	.025	19.00
Total	lb.	------	------	172.99	------	------	147.31
Expenses:							
Seed	cwt.	0.65	9.00	5.85	0.65	9.00	5.85
Fertilizer	cwt.	1.0	6.10	6.10	1.0	6.10	6.10
Insecticide	acre	1.0	11.33	11.33	1.0	11.33	11.33
Insecticide application	acre	1.0	3.00	3.00	1.0	3.00	3.00
Herbicide	acre	1.0	3.20	3.20	1.0	9.20	9.20
Defoliant	acre	0.8	2.30	1.84	0.8	2.30	1.84
Defoliant application	acre	0.8	1.40	1.12	0.8	1.40	1.12
Tractor operation	hr.	4.86	1.79	8.70	4.86	1.79	8.70
Equipment operation	hr.	------	------	32.41	------	------	31.81
Ginning, bagging and ties	cwt.-lint	------	------	13.64	------	------	6.89
Interest on operating capital	acre	------	------	3.51	------	------	3.55
Miscellaneous	acre	------	------	1.00	------	------	1.00
Labor — chopping and picking	--------	------	------	21.67	------	------	23.80
Other labor	--------	------	------	6.66	------	------	6.51
Total	--------	------	------	120.64	------	------	121.81

Appendix Table 9.—Returns and specified costs per acre of cotton on sandy soils by type of irrigation system, no response year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	208.97	208.97	208.97	205.54
Basic specified costs	142.12	142.12	142.12	132.68
Returns before irrigation costs	66.85	66.85	66.85	72.86
Irrigation costs				
Overhead	7.91	7.01	3.69	....
Operating	6.07	6.58	3.44	....
Total irrigation costs	13.98	13.59	7.13	....
Net returns[1]	52.87	53.26	59.72	72.86

[1] Returns to land and management.

Appendix Table 10.—Returns and specified costs per acre of cotton on sandy soils by type of irrigation system, moderately dry year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	239.81	239.81	239.81	208.97
Basic specified costs	146.81	146.81	146.81	133.23
Returns before irrigation costs	93.00	93.00	93.00	75.74
Irrigation costs				
Overhead	7.91	7.01	3.69	....
Operating	14.80	12.89	6.32	....
Total irrigation costs	22.71	19.90	10.01	. . .
Net returns[1]	70.29	73.10	82.99	75.74

[1] Returns to land and management.

Appendix Table 11.—Returns and specified costs per acre of cotton on sandy soils by type of irrigation system, dry year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	256.90	256.90	256.90	174.71
Basic specified costs	149.41	149.41	149.41	127.99
Returns before irrigation costs	107.49	107.49	107.49	46.72
Irrigation costs				
Overhead	7.91	7.01	3.69	....
Operating	17.71	16.05	7.76	....
Total irrigation costs	25.62	23.06	11.45	....
Net returns[1]	81.87	84.43	96.04	46.72

[1] Returns to land and management.

Appendix Table 12.—Returns and specified costs per acre of cotton on sandy soils by type of irrigation system, dry wet year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	156.18	156.18	156.18	192.49
Basic specified costs	134.06	134.06	134.06	130.66
Returns before irrigation costs	22.12	22.12	22.12	61.83
Irrigation costs				
Overhead	7.91	7.01	3.69	....
Operating	11.89	9.74	4.88	....
Total irrigation costs	19.80	16.75	8.57	....
Net returns[1]	2.32	5.37	13.55	61.83

[1] Returns to land and management.

Appendix Table 13.—Returns and specified costs per acre of cotton on loam soils by type of irrigation system, no response year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	181.55	181.55	181.55	181.55
Basic specified costs	130.74	130.74	130.74	121.37
Returns before irrigation costs	50.81	50.81	50.81	60.18
Irrigation costs				
Overhead	7.91	7.01	3.69	....
Operating	6.07	6.58	3.44	....
Total irrigation costs	13.98	13.59	7.13	....
Total irrigation costs	13.98	13.59	7.13	....
Net returns[1]	36.83	37.22	43.68	60.18

[1] Returns to land and management.

Appendix Table 14.—Returns and specified costs per acre of cotton on loam soils by type of irrigation system, moderately dry year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	222.66	222.66	222.66	188.42
Basic specified costs	136.99	136.99	136.99	122.35
Returns before irrigation costs	85.67	85.67	85.67	66.07
Irrigation costs				
Overhead	7.91	7.01	3.69	....
Operating	14.80	12.89	6.32	....
Total irrigation costs	22.71	19.90	10.01	....
Net returns[1]	62.96	65.77	75.66	66.07

[1] Returns to land and management.

Appendix Table 15.—Returns and specified costs per acre of cotton on loam soils by type of irrigation system, dry year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	243.21	243.21	243.21	174.71
Basic specified costs	150.42	150.42	150.42	120.27
Returns before irrigation costs	92.79	92.79	92.79	54.44
Irrigation costs				
Overhead	7.91	7.01	3.69	......
Operating	17.71	16.05	7.76	......
Total irrigation costs	25.62	23.06	11.45	......
Net returns[1]	67.17	69.73	81.34	54.44

[1] Returns to land and management.

Appendix Table 16.—Returns and specified costs per acre of cotton on loam soils by type of irrigation system, dry-wet year, Delta Area of Mississippi.

Item	Type of irrigation			
	Sprinkler	Gated pipe	Syphon tube	Dryland
	Dollars	Dollars	Dollars	Dollars
Gross returns	147.31	147.31	147.31	172.99
Basic specified costs	121.81	121.81	121.81	120.64
Returns before irrigation costs	25.50	25.50	25.50	52.35
Irrigation costs				
Overhead	7.91	7.01	3.69	......
Operating	11.89	9.74	4.88	......
Total irrigation costs	19.80	16.75	8.57	......
Net returns[1]	5.70	8.75	16.93	52.35

[1] Returns to land and management.

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Mississippi County Population Estimates 1962

By ELLEN S. BRYANT

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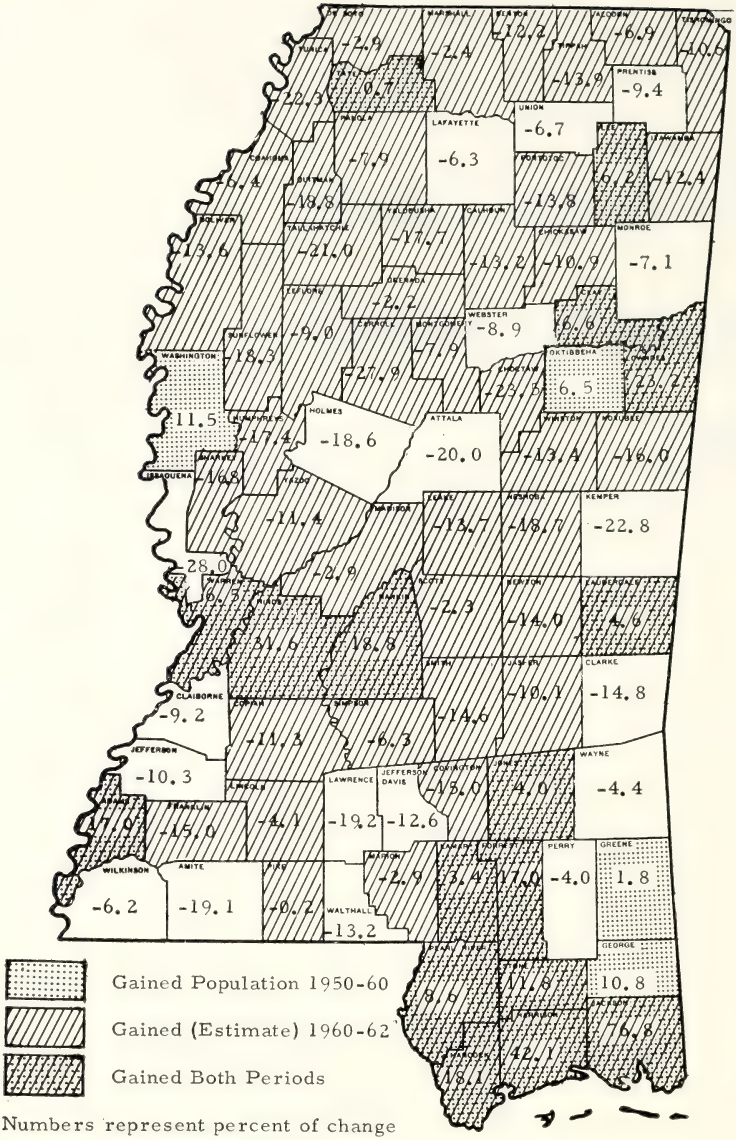
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ALCORN -6.9
TISHOMINGO -10.6
TUNICA -22.3
TATE 0.7
TIPPAH -13.9
PRENTISS -9.4
UNION -6.7
PANOLA -7.9
LAFAYETTE -6.3
LEE 6.2
ITAWAMBA -12.4
COAHOMA -16.4
QUITMAN -18.8
PONTOTOC -13.8
BOLIVAR -13.6
TALLAHATCHIE -21.0
YALOBUSHA -17.7
CALHOUN -13.2
CHICKASAW -10.9
MONROE -7.1
GRENADA -2.2
LEFLORE -9.0
CLAY 6.6
WEBSTER -8.9
SUNFLOWER -18.3
CARROLL -27.9
MONTGOMERY -7.9
WASHINGTON 11.5
OKTIBBEHA 6.5
CHOCTAW -23.5
LOWNDES 23.2
HUMPHREYS -17.4
HOLMES -18.6
ATTALA -20.0
WINSTON -13.4
NOXUBEE -16.0
SHARKEY -16.8
ISSAQUENA -28.0
YAZOO -11.4
MADISON -2.9
LEAKE -13.7
NESHOBA -18.7
KEMPER -22.8
WARREN 6.5
HINDS 31.6
RANKIN 18.8
SCOTT -2.3
NEWTON -14.0
LAUDERDALE 4.6
SMITH -14.6
JASPER -10.1
CLARKE -14.8
CLAIBORNE -9.2
COPIAH -11.3
SIMPSON -6.3
JEFFERSON -10.3
LAWRENCE -19.2
JEFFERSON DAVIS -12.6
COVINGTON -15.0
JONES 4.0
WAYNE -4.4
ADAMS 17.0
FRANKLIN -15.0
LINCOLN -4.1
MARION -2.9
LAMAR 3.4
FORREST 17.0
PERRY -4.0
GREENE 1.8
WILKINSON -6.2
AMITE -19.1
PIKE -0.2
WALTHALL -13.2
PEARL RIVER 8.6
STONE 11.8
GEORGE 10.8
HARRISON 42.1
JACKSON 76.8
HANCOCK 18.1
Gained Population 1950-60
Gained (Estimate) 1960-62
Gained Both Periods

Numbers represent percent of change
1950-60

Mississippi County Population Estimates 1962

By ELLEN S. BRYANT

Rapid growth of the white population was evident in many areas of Mississippi during 1962, according to the most recent county population estimates prepared at Mississippi State University. This population growth is a continuation of an observed 1960-61 trend, but a sharp reversal of the state's earlier tendency for heavy outmigration of its population. While state increases in the white population were again the most outstanding, the State also accrued slight nonwhite gains.

The 1962 estimated population size for the whole state is 2,258,000 of which 1,321,000 are white persons and 937,000 are nonwhites. These figures represent a proportional increase since 1960 of 3.7 percent for the total state population, 5.1 percent for the white, and 1.8 percent for the nonwhite.

During the same period the national population increased by an estimated 3.6 percent,[1] thus placing Mississippi's total and white growth rates ahead of the national average and indicating that white persons are continuing to move into the state in increasing numbers since the start of the new decade.[2] The total numerical growth in the state over the approximate two-year period amounted to nearly 80 thousand, of which about 64 thousand were white and 16 thousand nonwhite.

Of this approximate 64 thousand white increment, a little over half can be attributed to natural increase, or a balance of births over deaths. According to Mississippi's registered births and deaths,[3] the state's natural population growth during the period should have amounted to an increase of 36.2 thousand white persons and 48.3 thousand nonwhites. Thus, in order to reach the 1962 estimated size, Mississippi had to gain an additional 27,400 new white residents and lose about 32,000 nonwhites since the date of the 1960 Census. See Table 1.

The possibility of permanent change in the direction of movement of Mississippi's white population was first noted in the report on 1961 population estimates.[4] However, an examination of the intercensal estimates for the 1950's[5] indicates that a slow general population growth probably began to develop in the state by about 1957 or 1958 and has continued into the new decade to produce a rather impressive growth pattern.

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[1] U. S. Bureau of the Census, **Current Population Reports,** Series P-25, No. 259, November 26, 1962.

[2] Growth rates in Mississippi between 1960 and 1961 were estimated at 1.6% for the total population, 2.2% for the white population and 0.8% for the nonwhite. For the nation, the Census Bureau estimated the 1960-61 growth rate at 2.1 percent. See (1) Ellen S. Bryant, **Estimated Population Trends, Mississippi, 1960-61,** Bulletin 659. State College: Mississippi Agricultural Experiment Station, February 1963; and (2) U. S. Bureau of the Census, **Current Population Reports,** Series P-25, No. 258, November 21, 1962.

[3] Birth and death statistics are from the Mississippi State Board of Health, Jackson, Mississippi.

[4] See Bryant, **op. cit.,** pp. 3-4.

[5] See (1) Harald A. Pedersen and Leila H. Thomas, **Estimated Population Trends in Mississippi, 1955-56,** Bulletin 550. State College: Mississippi Agricultural Experiment Station, April 1957; and (2) George L. Wilber and Ellen Bryant, **Estimated Mississippi Population, 1950 to 1959,** Preliminary Report in Sociology and Rural Life No. 12. State College: Mississippi Agricultural Experiment Station, June 1960.

Therefore, Mississippi's new growth tendency may already be stabilizing into a long-term trend, and should not be dismissed as mere temporary fluctuation in the earlier loss pattern. However, there is still need for a great deal of critical caution in interpreting population trends in the state, particularly at the county level where small numerical changes often translate into high proportional variations.

To explain inmovements of population in a modern, mobile society, it is always necessary to look at least in part for accompanying changes in the area's economy. Accordingly, it is not surprising to find again in 1962 that the continuing population growth in Mississippi is concurrent with a continuously expanding state economy. For instance, the Mississippi Index of Business Activity, as computed by the Bureau of Business and Research at this University shows that business activity in Mississippi increased between late 1961 and late 1962 by about 10 percent in new economic growth.

During the same period, the business activity in the nation increased by only about three percent and part of this gain represented recovery from the 1960-61 national recession.[6] Thus with the state's economic growth rate outstripping that of the nation, it is not surprising that much of her population gain is also ahead of the national average.

Employment in wage and salary jobs in the state has also continued to increase at an expanding rate from an average of 403.4 thousand in 1960 to 407.2 thousand in 1961 to 421.5 thousand in 1962. The full range of this job growth reaches from 397.7 in January of 1960 to 435.2 in December of 1962, for a total employment growth rate of nearly 10 percent over the three year period.[7]

County Trends

Population growth varied widely between individual counties in the state, but some measure of increase (either white, nonwhite, or both) was spread over about 70 of the 82 counties. In all, 24 counties gained both white and nonwhites, while 23 gained only whites and 20 only non-whites. The counties with white growth only were predominantly in the western half of the state, particularly in the Delta area. Nonwhite-only growth had some concentration in the south-central and northeast portions of the state. A majority of the counties showing increments of both whites and nonwhites contained or were adjacent to counties with sizeable urban centers. In fact 70 percent of the state's recent population growth for both races occurred in the 17 counties with urban centers of 10,000 or more.[8]

Hinds and the Gulf Coast counties, which are the most highly urbanized areas of the state, themselves accounted for around 60 percent of the increment in these 17 counties. During the 1950's it was in these same urbanized counties that most of the population increases took place, and out of the group Lowndes, Lauderdale, Hinds, Warren, Adams, Pearl River, Harrison and Jackson counties have had consistent population increases since 1940.

Movements Within Mississippi

Of the 31 counties which in 1961 instigated new growth in the total population after a preceding decade of decline[9], 13 slipped back into their earlier loss trend in 1962. Similarly 12 out of the 26 counties newly gaining whites and 14 of the 29 newly gaining nonwhites in 1961 regressed back to population losses in 1962. On the other hand some which were losing in 1961 showed increases in 1962.

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[6] Louis M. O'Quinn, "The Business Outlook for 1963", **Mississippi Business Review**, 24 (7):6 (January 1963).

[7] See **Mississippi Labor Market**, monthly reports of the Mississippi Employment Security Commission, (November 1961 through January 1963).

[8] Includes Adams, Alcorn, Bolivar, Coahoma, Forest, Harrison, Hinds, Jackson, Jones, Lauderdale, Leflore, Lee, Lowndes, Pike, Warren, Washington, and Yazoo. However all of these counties did not show growth gains according to the latest estimates.

[9] See Bryant, **op.cit,. pp. 6-10.**

Apparently sizeable population movements are taking place within the state as well as between Mississippi and other states in the Nation. The 1961 estimates showed a tendency for increases in many predominantly rural counties, but in 1962 growth was concentrated in the more urban areas of the state.

These shifts are probably, at least in part, a response to changing labor needs in the state as well as in the nation. Contracting job opportunities in the cities have undoubtedly triggered at least a limited return of people to rural areas or origin, and it is undoubtedly more than coincidence that many rural counties in Mississippi showed population increases in 1961 when the nation was generally suffering from or just recovering from the 1960-61 national recession.

Summary

Mississippi is apparently embarking on a period of population growth and expansion unparalleled at any time in it's recent history and currently outranking the average national growth rates. Essentially the growth is part of a complex pattern of urbanization involving both the immigration of sizeable numbers of white persons into the state and most probably seesaw movements of people both within and to and from the state. In addition, nonwhites seem to be staying in the state in slightly increasing proportions.

Whether or not these growth trends continue into the future is, of course, uncertain and depends on a number of economic, social, and demographic factors. However, in view of the relative stability, the extending period of the recent growth, and its correlation with recent economic developments in the state, it is reasonable to assume that generalized population growth will probably continue in Mississippi at least into the immediate future.

Table 1.—Estimated net migration, Mississippi, from April 1, 1960, to July 1, 1962.

Mississippi population	1960 population	Natural increase	Total expected population[1]	Estimated average 1962 population	Estimated net migration[2]
Total	2,178,141	84,488	2,262,629	2,258,130	—4,500
White	1,257,546	36,179	1,293,725	1,321,140	27,410
Nonwhite	920,595	48,309	968,904	936,990	—31,910

[1] Col. 1 plus Col. 2 [2] Col. 4 minus Col. 3

Data Sources: U. S. Bureau of the Census and Mississippi State Board of Health.

Table 2.—Estimated Mississippi total county populations, 1961[1] and 1962[1] and trends since 1950.

Mississippi	Population			Percent Change		
Counties	1962	1961	1960	60-62	60-61	50-60
State	2,258,130	2,212,580	2,178,141	3.7	1.6	-----
Adams	38,570	37,520	37,730	2.2	—0.6	17.0
Alcorn	27,300	26,120	25,282	8.0	3.3	—6.9
Amite	15,320	14,920	15,573	—1.6	—4.2	—19.1
Attala	20,650	22,080	21,335	—3.2	3.5	—19.9
Benton	7,800	7,980	7,723	1.0	3.4	—12.2
Bolivar	56,330	56,950	54,464	3.4	4.6	—13.6
Calhoun	16,390	16,840	15,941	2.8	5.6	—13.2
Carroll	13,190	11,770	11,177	18.1	5.3	—27.9
Chickasaw	17,720	16,850	16,891	4.9	------	—10.9
Choctaw	8,500	8,320	8,423	1.0	—1.3	—23.5
Claiborne	10,250	10,660	10,845	—5.5	—1.7	—9.2
Clarke	15,550	15,990	16,493	—5.7	—3.0	—14.8
Clay	19,200	19,210	18,933	1.4	1.5	6.6
Coahoma	49,620	48,980	46,212	7.4	6.0	—6.4
Copiah	27,790	27,320	27,051	2.7	1.0	—11.3
Covington	41,270	13,690	13,637	4.7	------	—15.0
De Soto	24,330	24,650	23,891	1.8	3.2	—2.9
Forrest	55,550	56,250	52,722	5.4	6.7	17.0
Franklin	9,720	9,430	9,286	4.6	1.5	—15.0
George	11,120	11,480	11,098	—0.2	3.4	10.8
Greene	8,320	8,170	8,366	—0.7	—2.3	1.8
Grenada	19,030	19,620	18,409	3.3	6.6	—2.2
Hancock	14,920	14,760	14,039	6.3	5.1	18.1
Harrison	130,070	118,390	119,489	8.9	—0.9	42.1
Hinds	198,680	189,840	187,045	6.2	1.5	31.6
Holmes	25,700	28,300	27,096	—5.2	4.4	—18.6
Humphreys	19,220	19,500	19,093	0.6	2.6	—17.4
Issaquena	2,350	3,080	3,576	—34.1	—14.0	—28.0
Itawamba	15,590	14,700	15,080	3.4	—2.6	—12.4
Jackson	62,930	57,330	55,522	13.3	3.3	76.8
Jasper	19,640	17,340	16,909	16.1	2.6	—10.6
Jefferson	9,750	10,640	10,142	—3.8	5.0	—10.3
Jefferson Davis	13,540	12,940	13,540	------	—4.4	—12.6
Jones	59,980	60,670	59,542	0.7	1.9	4.0
Kemper	10,750	13,000	12,277	—12.4	5.9	—22.8
Lafayette	21,250	22,550	21,355	—0.5	5.6	—6.3
Lamar	15,130	14,510	13,675	10.7	6.1	3.4
Lauderdale	70,500	69,710	67,119	10.5	3.9	4.6
Lawrence	9,840	9,630	10,215	—3.7	—5.7	—19.2
Leake	19,570	17,960	18,660	4.9	—3.8	—13.7
Lee	41,330	41,560	40,589	1.8	2.4	6.2
Leflore	48,100	48,430	47,142	2.0	2.7	—9.0

Table 2—(Con't.)

Lincoln	28,180	27,120	26,759	5.3	1.4	—4.1
Lowndes	50,200	47,790	46,639	7.6	2.5	23.2
Madison	33,230	32,780	32,904	1.0	—0.4	—2.8
Marion	23,470	24,540	23,293	0.7	5.3	—2.8
Marshall	25,020	24,250	24,503	2.1	—1.0	—2.4
Monroe	33,550	31,970	33,953	—1.2	—5.8	—7.1
Montgomery	15,020	15,130	13,320	12.7	13.6	—7.9
Neshoba	21,510	20,220	20,927	2.8	—3.4	—18.7
Newton	20,680	21,010	19,517	6.0	7.6	—14.0
Noxubee	17,080	16,730	16,826	1.5	—0.6	—16.0
Oktibbeha	26,120	27,160	26,175	—0.2	3.8	6.5
Panola	31,590	29,230	28,791	9.7	1.5	—7.9
Pearl River	23,280	22,350	22,411	4.0	------	8.6
Perry	8,140	8,120	8,745	—6.8	—7.2	—4.0
Pike	35,820	36,290	35,063	2.1	3.5	------
Pontotoc	19,180	18,150	17,232	11.3	5.3	—13.8
Prentiss	17,650	18,500	17,949	—1.7	3.0	—9.4
Quitman	21,660	21,510	21,019	3.0	2.4	—18.8
Rankin	36,230	35,460	34,322	5.5	3.3	18.8
Scott	22,090	20,890	21,187	4.2	—1.4	—2.3
Sharkey	11,440	11,340	10,738	6.5	5.6	—16.8
Simpson	21,700	20,060	20,454	6.1	—1.9	—6.3
Smith	14,250	14,230	14,303	0.4	—0.5	—14.6
Stone	8,680	7,190	7,013	23.8	2.5	12.0
Sunflower	48,730	47,760	45,750	6.5	4.4	—18.3
Tallahatchie	24,580	24,390	24,081	2.0	1.3	—21.0
Tate	19,060	17,980	18,138	5.1	—0.9	0.7
Tippah	16,390	15,220	15,093	8.6	0.8	—13.9
Tishomingo	14,620	15,010	13,889	5.2	8.1	—10.6
Tunica	17,230	16,920	16,826	2.4	0.6	—22.3
Union	18,830	18,040	18,904	—0.4	—4.6	—6.7
Walthall	12,780	13,390	13,512	—5.3	—0.9	—13.2
Warren	43,570	41,900	42,406	2.4	—0.7	6.5
Washington	76,480	78,660	78,638	—3.7	------	11.5
Wayne	15,820	16,220	16,258	—2.7	—0.3	—4.4
Webster	10,460	11,180	10,580	—1.1	5.6	—8.8
Wilkinson	12,080	13,160	13,235	—8.8	—0.5	—6.2
Winston	19,980	18,310	19,246	3.7	—4.9	—13.4
Yalobusha	12,400	12,260	12,502	0.8	—1.9	—17.7
Yazoo	33,990	30,470	31,653	7.4	—3.7	—11.4

[1] Midyear

Percents not given when less than one half of one percent.

Estimates are rounded.

Prepared by the Vital Rates Method. For an evaluation of the procedure see MAES Bulletin 659, February 1963, referred to in the text of this article.

Table 3.—Estimated Mississippi white county populations, 1961[1] and 1962[1] and trends since 1950.

Mississippi	Population			Percent Change		
Counties	1962	1961	1960	60-62	60-61	50-60
State	1,321,140	1,284,660	1,257,546	5.1	2.2	5.8
Adams	19,340	18,860	19,035	1.6	—0.9	17.8
Alcorn	23,930	22,760	21,949	9.0	3.7	—10.0
Amite	6,940	6,780	7,130	—2.6	—4.9	—19.2
Attala	11,840	12,620	11,789	0.5	7.0	—21.8
Benton	4,260	4,590	4,114	3.6	11.5	—16.8
Bolivar	18,880	17,600	17,521	7.8	0.5	—11.8
Calhoun	11,910	12,300	11,595	2.7	6.1	—17.6
Carroll	6,270	5,020	4,677	34.0	7.2	—29.8
Chickasaw	10,750	10,270	10,380	3.6	—1.1	—1.4
Choctaw	6,240	5,890	5,903	5.8	......	—23.1
Claiborne	2,720	2,660	2,600	4.8	2.2	—13.6
Clarke	9,120	9,710	10,001	—8.8	—2.9	—12.9
Clay	7,920	8,980	9,214	—14.0	—2.6	20.3
Coahoma	16,140	16,110	14,630	10.3	10.1	6.8
Copiah	12,910	13,550	12,992	—0.7	4.3	—8.6
Covington	9,360	8,960	8,896	5.2	0.7	—17.8
De Soto	10,890	9,730	9,248	17.7	5.2	14.5
Forrest	40,270	40,830	37,970	6.1	7.5	18.3
Franklin	5,750	5,580	5,486	4.7	1.8	—17.2
George	9,540	10,230	9,811	2.8	4.3	11.7
Greene	6,420	6,340	6,443	0.4	—1.7	—4.0
Grenada	10,230	10,160	9,352	9.3	8.7	3.9
Hancock	12,110	12,440	11,784	2.8	5.5	19.6
Harrison	109,700	99,840	100,233	9.4	.....	41.9
Hinds	115,540	112,440	112,205	3.0	.....	43.4
Holmes	7,170	7,620	7,595	5.6	.....	—13.9
Humphreys	6,260	5,860	5,758	8.6	1.7	—17.9
Issaquena	690	1,280	1,176	—41.1	8.8	—27.3
Itawamba	14,640	13,780	14,206	3.1	—3.0	—12.7
Jackson	50,760	46,180	44,658	13.7	3.4	81.1
Jasper	10,190	8,750	8,402	21.2	4.2	8.6
Jefferson	3,280	2,730	2,489	31.7	9.7	—13.8
Jefferson Davis	5,900	5,950	6,126	—3.6	—2.9	—11.1
Jones	43,460	44,890	44,095	—1.4	1.8	4.5
Kemper	4,320	5,350	4,828	—10.6	10.8	—25.3
Lafayette	14,140	15,590	14,110	0.2	10.5	—4.1
Lamar	12,290	12,080	11,443	7.4	5.5	2.9
Lauderdale	49,170	45,410	43,635	13.0	4.1	7.0
Lawrence	6,380	6,470	6,354	0.4	1.8	—19.4
Leake	11,440	10,320	10,559	8.4	—2.3	—15.2
Lee	30,330	31,460	30,300	0.1	3.8	9.9
Leflore	18,210	18,200	16,699	9.1	9.0	1.3

Table 3—(Con't.)

Lincoln	20,140	18,610	18,407	9.4	1.1	—1.6
Lowndes	31,990	29,910	28,871	10.8	3.6	48.5
Madison	11,120	9,500	9,267	20.0	2.5	3.8
Marion	14,920	16,550	15,408	—3.2	7.4	—1.1
Marshall	7,550	7,130	7,264	4.0	—1.9	—1.5
Monroe	22,460	20,290	21,932	2.4	—7.5	—3.9
Montgomery	9,280	8,380	7,349	26.3	13.6	—10.9
Neshoba	16,210	14,930	15,026	7.9	—0.6	—21.2
Newton	14,420	14,670	12,950	11.4	13.3	—12.7
Noxubee	4,620	5,000	4,724	—2.2	5.9	—7.7
Oktibbeha	14,270	15,890	14,727	—3.1	7.9	14.9
Panola	13,580	12,660	12,565	8.1	0.8	—8.8
Pearl River	18,450	17,350	17,221	7.2	0.7	6.2
Perry	6,100	6,110	6,333	—3.6	—3.6	—8.2
Pike	20,170	20,690	19,655	2.6	5.2	1.2
Pontotoc	15,620	14,960	13,946	12.0	7.3	—13.8
Prentiss	15,330	16,060	15,763	—2.8	1.9	—9.8
Quitman	8,880	7,880	7,715	15.1	2.1	—24.2
Rankin	21,330	22,590	21,504	—0.8	5.1	41.4
Scott	14,120	13,850	13,050	8.2	6.1	6.0
Sharkey	3,680	3,380	3,247	13.3	4.1	—12.4
Simpson	14,010	12,300	13,254	5.7	—7.2	—8.9
Smith	10,880	10,980	11,056	1.6	—0.7	—17.2
Stone	6,840	5,490	5,302	29.1	3.5	8.2
Sunflower	15,500	16,250	14,730	5.2	10.3	—17.6
Tallahatchie	8,770	8,570	8,580	2.2	....	—22.5
Tate	8,190	7,830	7,696	6.4	1.7	0.7
Tippah	13,730	12,290	12,337	11.3	....	—12.7
Tishomingo	13,850	14,280	13,210	4.8	8.1	—10.4
Tunica	3,640	4,080	3,505	3.7	16.5	—11.1
Union	15,850	15,100	15,592	1.6	—3.2	—6.2
Walthall	7,020	7,370	7,412	—5.3	—0.5	—11.7
Warren	22,980	22,270	22,447	2.4	—0.8	15.0
Washington	35,120	33,830	35,239	—0.3	—4.0	50.4
Wayne	10,140	10,680	10,449	—3.0	2.2	—3.2
Webster	7,450	7,980	7,938	—6.1	0.5	—11.0
Wilkinson	2,990	3,660	3,807	—21.6	—3.8	—12.6
Winston	12,080	10,140	10,853	11.3	—6.6	—16.1
Yalobusha	6,960	6,750	6,962	....	—3.0	—18.4
Yazoo	13,290	12,320	12,862	3.3	—4.3	—5.6

[1] Midyear

Percents not given when less than one half of one percent.

Estimates are rounded.

Prepared by the Vital Rates Method. For an evaluation of the procedure see MAES Bulletin 659, February 1963, referred to in the text of this article.

Table 4.—Estimated Mississippi nonwhite County Populations, 1961[1] and 1962[1] and Trends Since 1950.

Mississippi	Population			Percent Change		
Counties	1962	1961	1960	60-62	60-61	50-60
State	936,990	927,920	920,595	1.8	0.8	—7.0
Adams	19,230	18,660	18,695	2.9	.....	16.1
Alcorn	3,370	3,350	3,333	1.2	0.6	—14.6
Amite	8,380	8,130	8,443	—0.8	—3.7	—19.1
Attala	8,810	9,460	9,546	—7.7	—0.9	—17.5
Benton	3,540	3,400	3,609	—2.1	—5.9	—6.3
Bolivar	37,450	39,350	36,943	1.4	6.5	—14.4
Calhoun	4,480	4,540	4,346	3.2	4.4	1.3
Carroll	6,920	6,750	6,500	6.5	3.9	—26.4
Chickasaw	6,970	6,580	6,511	7.0	1.1	—22.7
Choctaw	2,260	2,420	2,520	—10.3	—3.9	—24.3
Claiborne	7,530	8,010	8,245	—8.7	—2.9	—7.7
Clarke	6,430	6,280	6,492	—1.0	—3.3	—17.6
Clay	11,280	10,230	9,719	16.1	5.3	—3.7
Coahoma	33,480	22,880	31,582	6.0	4.1	—11.4
Copiah	14,880	13,780	14.059	5.9	2.0	—13.7
Covington	4,910	4,730	4,741	3.6	.....	—9.1
DeSoto	13,440	14,920	14,643	—8.5	2.0	—11.4
Forrest	15,280	15,420	14,752	3.6	4.5	13.8
Franklin	3,970	3,840	3,800	4.4	1.1	—11.7
George	1,580	1,250	1,287	22.8	—3.0	4.5
Greene	1,900	1,830	1,923	—1.5	—4.6	27.9
Grenada	8,800	9,460	9,057	—2.9	4.4	—7.9
Hancock	2,810	2,330	2,255	24.5	3.1	10.6
Harrison	20,370	18,550	19,256	5.8	—3.7	43.5
Hinds	83,140	77,400	74,840	11.1	3.4	17.1
Holmes	18,530	20,680	19,501	—5.0	6.0	—20.3
Humphreys	12,960	13,730	13,335	—2.8	3.0	—17.2
Issaquena	1,660	1,800	2,400	—30.7	—25.2	—28.3
Ittawamba	950	910	874	8.9	4.2	—6.7
Jackson	12,170	11,150	10,864	12.0	2.6	61.3
Jasper	9,450	8,590	8.507	11.0	1.0	—12.5
Jefferson	6,470	7,910	7,653	—15.4	3.4	—9.1
Jefferson Davis	7,640	6,990	7,414	3.0	—5.7	—13.9
Jones	16,520	15,780	15,447	6.9	2.2	—2.9
Kemper	6,430	7,650	7,449	—13.7	2.7	—21.0
Lafayette	7,110	6,960	7,245	—1.9	—4.0	—10.4
Lamar	2,840	2,430	2,232	27.4	9.1	6.0
Lauderdale	21,330	24,300	23,484	—9.2	3.5	0.4
Lawrence	3,460	3,160	3,861	—10.3	—18.1	—18.9
Leake	8,130	7,640	8,101	0.4	—5.7	—11.6
Lee	11,000	10,100	10,289	6.9	—1.8	—3.5
Leflore	29,890	30,230	30,443	—2.0	—0.7	—13.8

Table 4—(Con't.)

Lincoln	8,040	8,510	8,352	—3.8	1.9	—9.1
Lowndes	18,210	17,880	17,768	2.5	0.7	—3.5
Madison	22,110	23,280	23,637	—6.6	—1.5	—5.2
Marion	8,550	7,990	7,885	8.4	1.3	—6.0
Marshall	17,470	17,130	17,239	1.3	—0.7	—2.8
Monroe	11,090	11,680	12,021	—7.7	—2.8	—12.3
Montgomery	5,740	6,780	5,971	—4.0	13.6	—4.1
Neshoba	5,300	5,290	5,901	—10.2	—10.4	—11.5
Newton	6,260	6,340	6,567	—4.7	—3.5	—16.4
Noxubee	12,460	11,730	12,102	2.8	—3.1	—18.8
Oktibbeha	11,850	11,270	11,448	3.5	—1.5	—2.6
Panola	18,010	16,570	16,226	11.0	2.1	—7.2
Pearl River	4,830	5,010	5,190	—6.9	—3.5	15.5
Perry	2,040	2,010	2,412	—15.2	—16.7	9.1
Pike	15,650	15,610	15,408	1.5	1.3	—1.9
Pontotoc	3,560	3,190	3,286	8.3	—3.0	—13.9
Prentiss	2,320	2,440	2,186	5.9	11.6	—6.3
Quitman	12,780	13,640	13,304	—4.0	2.5	—15.3
Rankin	14,900	12,860	12,818	16.2	...	—6.2
Scott	7,970	7,050	8,137	—2.1	—13.4	—13.2
Sharkey	7,760	7,960	7,491	3.6	6.3	—18.5
Simpson	7,690	7,760	7,200	6.8	7.8	—1.0
Smith	3,370	3,250	3,247	3.8	.....	—4.2
Stone	1,840	1,700	1,711	7.5	.....	25.3
Sunflower	33,230	31,510	31,020	7.1	1.6	—18.7
Tallahatchie	15,810	15,820	15,501	2.0	2.1	—20.1
Tate	10,870	10,150	10,442	4.1	—2.8	0.7
Tippah	2,660	2,920	2,756	—3.3	6.1	—18.8
Tishomingo	770	730	679	13.4	6.8	—15.8
Tunica	13,590	12,840	13,321	2.0	—3.6	—24.8
Union	2,980	2,940	3,312	—10.1	—11.2	—8.9
Walthall	5,760	6,020	6,100	—5.5	—1.4	—14.9
Warren	20,590	19,630	19,759	4.2	—0.6	—1.7
Washington	41,360	44,830	43,399	—4.7	3.2	—7.8
Wayne	5,680	5,530	5,809	—2.2	—4.8	—6.6
Webster	3,010	3,200	2,642	13.9	21.1	—1.9
Wilkinson	9,090	9,500	9,428	—3.3	0.8	—3.4
Winston	7,900	8,170	8,393	—5.8	—2.7	—9.7
Yalobusha	5,440	5,510	5,540	—1.8	—0.6	—16.8
Yazoo	20,700	18,150	18,791	10.2	—3.4	—14.9

[1] Midyear.

Percents not given when less than one half of one percent.

Estimates are rounded.

Prepared by the Vital Rates Method. For an evaluation of the procedure see MAES Bulletin 659, February 1963, referred to in the text of this article.

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Children's Influence On Family Food Purchase Decisions

By
DOROTHY DICKINS
and
ALVIRDA JOHNSTON

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Children's Influence On Family Food Purchase Decisions

BY DOROTHY DICKINS AND ALVIRDA JOHNSTON

Several studies have suggested that children play a role in family food decisions but none have defined the role or its importance. There is little, if any, direct research in this area. It is the purpose of this pilot study to learn (1) where the child hears about foods requested, what foods he requests, and whether or not requests are granted; and, if not, why not; and (2) what appeals are effective with young children. Such information is not only needed by educators but also by the food industry.

Scope and Methods

The study included 220 boys and girls of 9 and 10 years of age attending public schools located in Lowndes and Clay Counties, Mississippi. Children were selected from one rural school in Lowndes County (New Hope School) and from three urban schools in West Point, Clay County, (East Side Elementary, West Side Elementary, and West Point Junior High)[1].

Nine and 10 year old children were selected for this study as this age child is old enough to participate effectively in an interview with a stranger and have influence on food purchases.

The eligibility of the child was determined from an interview with the teacher or in the principal's office by filling out the child's record sheet. To be eligible the child (1) must be either 9 or 10 years of age; (2) must live with parents; (3) must have parents who were both born in the USA; and (4) must be of the white race.

Other basic data obtained at the school included the last grade completed in school and the kind of gainful occupation of each parent, as well as place of residence, whether urban or rural.

An attempt was made to get an equal number of rural and urban children, of boys and girls, and of 9 and 10 year old children. All of the 100 children attending New Hope school lived in rural areas; 20 of the 120 attending urban schools lived in rural areas; and the remaining 100 lived in urban areas. One hundred and ten of the children were boys; 110 were girls. One hundred of the children were 10 years of age; 120 were 9 years of age.

Description of Families

Most of the parents of the 220 children included had a high school education or more, as is shown:

Schooling	Fathers Percent	Mothers Percent
8 grades or less	20	11
9-11 grades	22	24
Finished high school	39	54
College (1 or more years)	19	11

Forty-four percent of the mothers had some sort of gainful work. The most common type of work was semi and unskilled wage work, usually factory work and white collar work such as managers, clerks, and kindred workers. Forty-four percent of those with gainful work had work of the former type; 38 percent, of the latter type.

Skilled wage work was the kind had by more fathers. Thirty-seven percent had this type of work, while 21 percent had semi and unskilled wage work, and 20 percent white collar work. Only 8 percent were farmers.

Eighty percent of the families had 4—6 members. Fifteen percent of the families had more than 6 members. About one-third of the children included were their mother's first child.

Collection of Data From Children

The children were interviewed at school one at a time in a private room, usually a room not in use during certain periods, such as the library, clinic, or a music room. All interviewing was done by Mrs.

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[1] Fifth and sixth grade children attended this Junior High School.

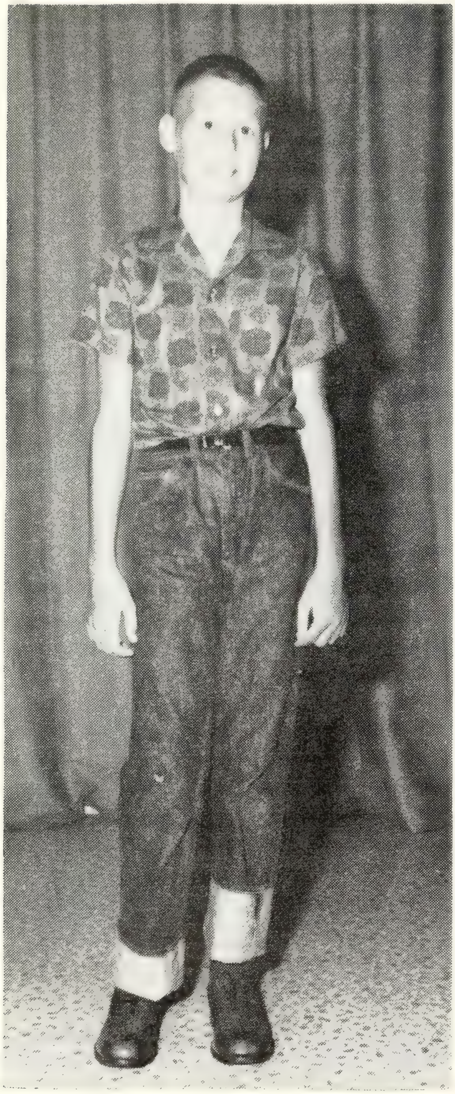

Figure 1. Picture of a boy named John whom the interviewer and girls talked about.

Alvirda Johnston, junior author of this report. The study was presented as follows: "I am trying to learn more about the way children and their parents decide about foods to buy. I am going to ask you some questions about food, what you like, and what new things you like to have your mother buy and fix for you. The answers you give me will help me learn about families and the things I should teach mothers and daddies and children about food. Will you help me?"

After the child had volunteered his cooperation he was asked about the number of people in his family and his position in the family — whether he was mother's first child, second child, etc.

Before launching on the discussion of foods the child was shown a picture of a boy or girl (depending on his particular sex) and told: We are going to talk about a boy named John (or a girl named Jane). Here is his (or her) picture. The child is shown the picture. See Figures 1 and 2.

Knowledge of Nutrition

Before asking the child about requests to buy food, several questions were introduced for the purpose of determining the child's knowledge of nutrition. These questions were: (1) What foods do you think John (Jane)[2] should eat each day? Are these the foods you eat every day? (2) John's (Jane's) mother has promised him (her) a dinner party for his (her) birthday and has told him (her) to make a list of the foods he (she) wants to serve. What foods do you think will be on the list?

The foods in the first questions were checked as to whether or not the child mentioned one or more foods in each of the four basic food groups. These are: (1) the milk group; (2) the meat group; (3) the vegetable-fruit group; and (4) the bread-cereal group.

As will be noted in Table 1, foods in the vegetable-fruit group were named most often as foods John or Jane should each day and as foods you (the interviewee) eat each day.

Bread and cereal were named least often. There was a tendency for a larger

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[2] Schedule blanks and pictures used with girls referred to girls and Jane; those used with boys referred to boys and John.

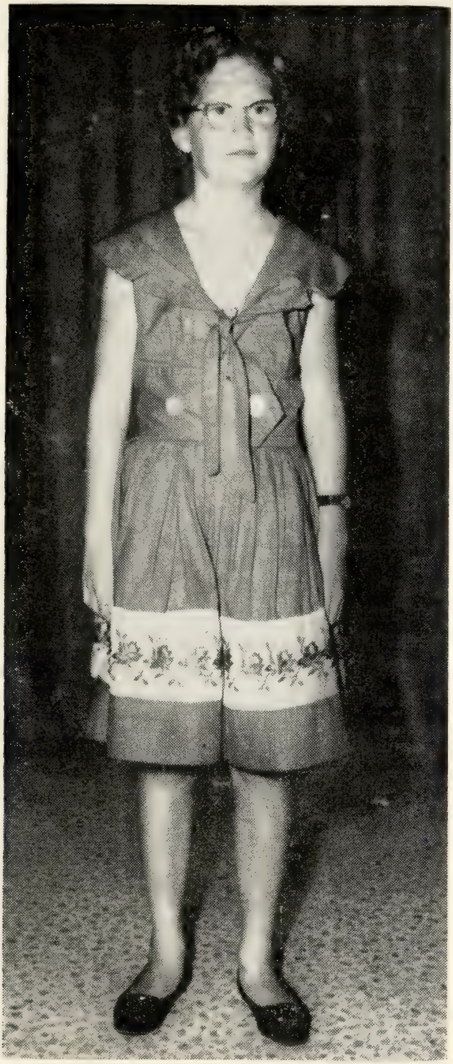

Figure 2. Picture of a girl named Jane whom the interview and girls talked about.

percentage of girls to mention foods in specified groups than of boys. However, differences were not statistically significant.

Relationships were studied of kind and number of basic food groups named that John (or Jane) should have each day and those you (the interviewee) eat each day, to education of mother, occupation of father, size of family, whether or not mother worked away from home, and location of child's home and school. In no case were statistically significant relationships found. However, relationships in location of child's home and school (whether urban or rural) and food groups named approached significance. Urban children more often named foods in the milk, meat, and vegetable-fruit groups than rural children. Rural children on the other hand more often named foods in the bread-cereal group than urban children.

How did replies to the question about foods John (Jane) should eat compare with replies to the question about foods **you** eat every day? (Table 1). As will be noted, John and Jane would get better diets than the child interviewed. In other words, these children knew more than they put into practice.

As will be noted (Table 1) the biggest difference in the food for John and Jane and in the food the child interviewed ate very day was in the meat group. More said John (Jane) should have foods in the meat group than ate meat everyday themselves. Most of those not eating meat mentioned "not served" and "don't have" as their reasons for not eating. Only 4 children mentioned disliking meat.

Table 1.—A comparison of foods John (Jane) should eat each day with those you (the interviewee) eat each day.

Basic groups	Percentage naming one or more foods			
	Boys		Girls	
	For John	What you do	For Jane	What you do
Milk group	76	72	87	79
Meat group	74	51	76	61
Vegetable-fruit group	95	91	97	88
Bread-cereal group	50	49	56	55

Table 2.—Percentage of boys and girls naming foods in one or more groups that John (Jane) should eat each day and those you (the) interviewee eat each day.

Number food groups	Percentage naming foods in one or more groups			
	Boys		Girls	
	For John	What you do	For Jane	What you do*
1	6	16	4	10
2	24	31	14	20
3	37	28	45	39
4	33	25	37	29

*Two percent mentioned foods in none of the four groups.

Table 3.—Number of foods named in each of the four basic groups by boys and girls which they would serve at a dinner party on their birthday.

No. foods	Boys				Girls			
	Milk	Meat	Vegetable-fruit	Bread-cereal	Milk	Meat	Vegetable-fruit	Bread-cereal
	Percent							
0	26	16	5	41	35	23	9	28
1	56	73	24	51	43	69	30	65
2	15	10	28	6	21	6	21	7
3	3	1	27	1	1	2	26	0
4	0	0	16	1	0	0	14	0

Children in this study had a knowledge about the kinds of foods needed. Seventy percent of the boys and 82 percent of the girls named foods in 3 or 4 of the basic groups John or Jane should have each day (Table 2).

Another question designed to determine the child's knowledge of nutrition concerned his list of foods to serve at a dinner party on a birthday (Table 3).

As will be noted in Table 3, the majority of children (both boys and girls) selected one milk product, one meat and one bread or cereal for a dinner party for the birthday dinner. Most children named 5 — 6 food items (44 percent of the boys and 50 percent of the girls) for the birthday dinner. Types of vegetables and fruits named varied greatly, but more named this food group than any other.

In no case were statistically significant relationships found in sex and choice of food for a birthday dinner. However, urban children mentioned meat more often than rural children. The four meats most often mentioned for this dinner party by both boys and girls were fried chicken, hamburger, steak, and ham.

Thirty-four percent of the boys and 40 percent of the girls did not name a dessert for their birthday dinner; but 41 percent of the boys and 37 percent of the girls named 2 or more desserts[3]. Only 20 percent of the boys and 23 percent of the girls named a caffein drink such as coffee, tea, coca cola.

When asked about what his mother would say about this list of foods for a dinner party on his birthday, the child of the more educated mother more often thought his choice would be acceptable than the child of the mother with little schooling. The less educated mother was more likely to say, "Too little; you should add something else".

In comparing the foods named when the child was questioned about foods he eats every day and foods he wanted for a birthday dinner, we found that more boys and girls mentioned foods in the meat and bread-cereal groups for the birthday dinner. On the other hand, fewer girls mentioned milk products in connection with the birthday dinner than as food eaten every day. With all these

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[3] Included sweet drinks such as powdered drinks, soft drinks.

Table 4.—Kinds of food requested when child went to grocery with parent and kinds of food purchased.*

Kinds of food	Boys		Girls	
	Requested	Mother bought	Requested	Mother bought
	Percent	Percent	Percent	Percent
Material for cooking	3	3	3	3
Snacks	20	15	32	25
Canned foods	14	14	13	13
Frozen foods	8	6	7	7
Dairy products	17	15	28	25
Cereals	28	25	24	20
Fruits & vegetables	40	38	40	38
Bakery products	5	5	12	11
Meats	29	26	40	38
Miscellaneous, such as olives, catsup, chocolate syrup	8	3	8	5

*Adds up to more than 100 percent as some named more than one kind of food.

tests there seemed to be a keen recognition on the part of children of foods in the vegetable-fruit group.

Requests of Child to Buy Food

As has been mentioned the main purpose of this study was to learn where the child hears about the foods he requested, what foods he requests, whether or not the requests are granted, and if not, why not. Sources of information studied included grocery stores; prizes, premiums; school lunch dishes; dishes served in homes of friends and relatives; television; radio; foods for you to fix; and other.

Grocery store shopping: The child was asked: "In the past few weeks have you been to the grocery store with your mother?" Eighty percent of the boys and 81 percent of the girls replied, "Yes". Twenty percent of the boys and 13 percent of the girls said they had not asked mother to buy any kind of food on these visits to the grocery store. This means that 60 percent of the boys and 68 percent of the girls asked her to buy one or more foods.

There was not a significant difference in boys and girls asking mother to buy foods (Table 4). But differences in requests of urban and rural children for canned foods (such as canned soup, apple sauce) was significant at the 5 percent level. More urban than rural children made such requests.

The 67 boys and 74 girls asking mother to buy food asked her to buy the following:

	Boys	Girls
	Percent	Percent
Asked to buy 1 food	28	25
Asked to buy 2 foods	34	35
Asked to buy 3 foods	28	16
Asked to buy 4 foods	8	12
Asked to buy 5 or more foods	1	9
No report as to number of foods	1	3

The three most important reasons for requesting the foods when grocery shopping with mother were((1) Like it, it's good; (2) To eat at recess, or as a snack; (3) For health; it's good for you. Three times more girls than boys mentioned needing the food, that they were out of it at home. Foods most often requested but not purchased were cereals, snacks, foods in the miscellaneous group, meats, and dairy products (Table 4). Most frequent reasons given for not purchasing the foods requested were: have it at home; don't need; can't afford; too many sweets.

Prizes, premiums: Each child was asked, "Have you ever sent a box top or coupon from some kind of food package to get a gift?" (in most cases, cash payment must accompany the coupon.) Thirty-seven percent of the boys and 36 percent of the girls replied, "Yes". In practically all cases the child reported the box top or coupon was from a cereal box. Eighty-three percent of the boys and 80 percent of the girls so reported.

Three-fourths of the boys and two-

Table 5.—Kinds of food child had eaten in school lunchroom and requested, and which of these mother had prepared.*

Kinds of food	Boys		Girls	
	Requested	Mother prepared	Requested	Mother prepared
	Percent	Percent	Percent	Percent
Main dish	38	29	38	23
Fruit, vegetable, salad	42	33	31	30
Desserts	18	13	21	18
Cereal, breads	2	2	2	2
Other dishes, as soups and sandwiches	7	5	8	5

*Adds up to more than 100 percent as some named more than one food.

Table 6.—Kinds of food child had eaten in home of friends and relatives and requested, and which of these his mother had prepared.*

Kinds of food	Boys		Girls	
	Requested	Mother prepared	Requested	Mother prepared
	Percent	Percent	Percent	Percent
Main dish	46	38	39	28
Fruit, vegetable, salad	13	13	23	17
Milk or milk products	2	2	6	3
Breads	3	3	4	1
Cereal dishes	3	0	1	0
Pies & other desserts	28	23	27	18
Other	7	7	8	7
Don't remember	2	—	1	—

*Adds up to more than 100 percent as some named more than one food.

thirds of the girls received some type of toy, game, book, or record for this box top or coupon. Other things the child got from sending off a coupon or box top were: Tableware; money; discount on more of the product; personal items such as finger nail clippers, necklace; and foods, such as candy, peanut butter.

School lunch dishes: Every child was asked four questions about food eaten in the school lunchroom: "Have you ever eaten a food at the school lunchroom that you had never had at home and liked it so well that you asked your mother to fix it? If yes, what was it? If yes, did she fix it? If no, why not?"

Fifty percent of the boys and 53 percent of the girls stated that they had eaten a food at the school lunchroom not eaten at home and liked it so well that they had asked mother to fix. Table 5 gives the types of foods requested and the percentage of mothers who had prepared the food requested.

Main dishes requested by a number of the children were Spanish rice cooked with meat; pinto beans; chili; meat; and fish salads. In the vegetable-fruit group a number requested a dish quite popular in school lunchrooms, sweet potatoes cooked with raisins. Desserts requested included banana pudding, rice pudding, gelatin dessert, sweet potato pie, cookies.

Most dishes requested by children were prepared by their mothers. Reasons most often given by the child when his mother did not prepare were: Mother doesn't know how; doesn't have ingredients that go in the dish; doesn't have time; hasn't gotten around to it; will fix someday; I don't know why she doesn't fix.

Dishes served in homes of friends and relatives: Fifty-six percent of the boys and 64 percent of the girls reported they had asked mother to fix something never served at home but eaten at the home of a friend or relative.

Table 6 gives the kinds of these foods requested of mother and the kinds she prepared. As will be noted, main dishes were the type most often requested as well as the type in which requests were less often granted.

Persons most often mentioned in connection with dishes eaten at homes of friends and relatives were:

Persons	By Boys	By Girls
	Percent	Percent
Grandmother & grandfather	41	39
Friend, neighbor, preacher	30	39
Aunt and uncle	18	23
Cousin	8	4
Sister	3	1

The most important reasons given for their mother not fixing dishes eaten in homes of friends and relatives were: Mother doesn't know how; she doesn't have the recipe; doesn't know what I'm talking about- tried to, but bought wrong thing. Other types of reasons given include: Don't have ingredients; will try sometimes —hasn't gotten around to it.

Television: The children were asked a number of questions about food advertising over television: "Have you watched TV in the last few weeks? If yes, have you heard some food advertised? Did you ask your mother to buy any of these foods you saw advertised? If yes, what foods? Which did she buy?" Then, there were two questions which were designed to show whether or not the child connected the food advertised with a specific television program. These questions were: "John (Jane) has been getting low grades at school. His (her) folks say he (she) can watch only two TV programs a week. What programs will he (she) watch? What foods will he (she) see advertised on these programs?"

Ninety-five percent of the boys and 97 percent of the girls said they had watched television in the last few weeks. Of those who had watched television 72 percent of the boys and 66 percent of the girls stated they had heard some food advertised and had asked mother to buy. Table 7 shows kinds of food they asked mother to buy and those which she bought.

Cereals, meat dishes (such as lunch meat, canned pork, bacon, meat pies), and bakery products were those advertised over television which the child most often asked mother to buy. Included under bakery products were cookies and mixes, frozen and ready-prepared.

Requests for cereals and snacks were granted less often than requests for other foods (see Table 7).

When asked about two television programs they would watch, the children mentioned 80 different programs. Those mentioned by more than 10 children, ranked according to the number mentioned, were (1) The Lucy Show (including the Lucy Comedy Hour and I Love

Table 7.—Kinds of food which child had heard advertised over television and requested, and which of these his mother bought.*

	Boys		Girls	
Kinds of food	Requested	Mother bought	Requested	Mother bought
	Percent	Percent	Percent	Percent
Cereals	23	19	28	18
Drinks	9	9	7	7
Desserts	6	6	6	3
Soup	14	13	9	9
Macaroni & spaghetti dishes	1	1	3	0
Peanut butter	3	0	3	1
Syrup, fruit sauce	1	1	4	3
Fruit, including fruit gelatin	7	7	16	15
Bakery products	9	7	22	19
Meat dishes	23	20	13	13
Vegetables, including green salads	11	10	7	7
Candy	1	1	1	0
Other snacks, such as potato chips, freeze-pops, Fritoes	23	7	6	3
Can't remember	6	—	0	—

*Adds up to more than 100 percent as some named more than one food.

Lucy); (2) Beverly Hillbillies; (3) Saturday Cartoons; (4) Red Skelton; (5) Gunsmoke; (6) Andy Griffith; (7) Rawhide; (8) Roy Rogers; (9) Deputy Dawg; (10) Danny Thomas; (11) Lassie. The urban child most often mentioned Beverly Hillbillies, Andy Griffith, Danny Thomas, The Lucy Show, and Red Skelton. The rural child most often mentioned Deputy Dawg, Gunsmoke, Rawhide, and Roy Rogers. Lassie and Saturday Cartoons were equally popular with both groups.

Television stations in the area were contacted about the type of advertising on the programs viewed by the children. These data were checked against reports given by children of the foods they saw advertised on their two favorite programs. Table 8 shows to what extent the child was correct about the foods advertised on specific television programs.

In about one-third of the programs the children were correct as to the food advertised on a particular television program. Slightly more girls than boys could give this information, but differences were not significant. Neither was there a significant difference found in abilities of urban and rural children to identify foods advertised on TV programs.

Radio: Seventy percent of the boys and 66 percent of the girls said they had listened to the radio in the last few weeks. Of those listening to the radio the vast majority (83 percent of the boys and 88 percent of the girls) said they had not heard food advertised; or, if they had, they did not ask mother to buy. Only 13 boys (12 percent) and 9 girls (8 percent) asked mother to buy any of the foods heard advertised over the radio.

The few requests for foods advertised over the radio were usually granted (table 9). Only in case of desserts asked for by girls was there a number of refusals of mother to buy.

Foods for you to fix: Every child was asked: "Have you ever requested mother to buy any foods for you to fix; and if yes, did she buy them?"

The replies of the boys and girls to this question might be summarized as follows:

	Boys	Girls
	Percent	Percent
No, I did not ask	70	35
Yes, I asked and she bought	30	60
Yes, I asked and she did not buy	0	5

Table 8.—Child's correctness about food advertised on the two TV programs he would watch if only allowed to watch two programs a week.

Item	Boys	Girls
	Percent	Percent
Child correct about food advertised	28	35
Child incorrect about food advertised	43	33
Don't know or don't remember	21	25
Doesn't look at TV	5	3
No information obtained about item advertised	2	3
Child reported on advertising of one program only	1	1
Total number of programs	220	220

Table 9.—Kinds of food which child had heard advertised over the radio and requested, and which of these his mother bought.*

	Boys		Girls	
Kinds of food	Requested	Mother bought	Requested	Mother bought
	Percent	Percent	Percent	Percent
Main dishes, meat, fish, poultry, other	31	31	33	33
Bread, rolls, buns, cereals	15	15	33	33
Desserts	31	31	33	22
Snacks & relishes	0	—	22	22
Canned goods, unspecified	8	8	0	—
Vegetables, fruits, salads	15	15	11	11
No reply	15	15	0	—

*Adds up to more than 100 percent as some named more than one food.

There was a highly significant relationship between sex of child and requests for foods for child to fix. As will be noted, such requests were much more popular with girls than with boys.

Table 10.—Food and/or material mother bought for child to fix.*

Kinds of food	Boys	Girls
	Percent	Percent
Bakery products, not sweet	9	8
Sweetened bakery products	18	61
Fruits, vegetables, salads	3	9
Meat, chicken, fish, dry beans	15	14
Dairy products	3	3
Other desserts and candies	21	17
Bacon and eggs	12	2
Snacks	15	3
Sandwiches, soup	12	6
Other (rice)	3	0

*In some cases mother had bought more than one kind of food.

Table 11.—Sources from which children learned about foods which they asked mother to buy for them to fix.

Sources*	Boys	Girls
	Percent	Percent
Mother	39	47
Home	21	11
Television	15	15
Sister	3	8
Grandmother	3	8
Scouts	9	2
Recipe on box or package	3	8
Father	6	2
Recipe book or cookbook	0	8
Friend or neighbor	0	3
Magazine	3	0
Made it up	3	0
Maid	0	2
4-H Club	0	2
Other (trip to Mexico)	0	2

*Some children had used more than one source.

Table 10 gives the kinds of food mother bought for child to fix. There was a highly significant difference between purchase of sweetened bakery products and sex. Sweetened bakery products included cake and cookies, mixes, refrigerated products and "other", such as cinnamon toast.

In Table 11 are given sources from which children learned about foods which they asked mother to buy for them to fix. As will be noted, the parental family (home, mother, sister) was the main source from which the child learned about fixing food. Television was likewise an important source.

Other: Each boy and girl was asked about "other" foods they had asked mother to have which they had not told us about. Forty percent of the boys and 43 percent of the girls remembered other foods.

Table 12 shows the "other" foods requested and which of these mother bought. As will be noted, mother was less likely to buy foods classified in this category. It may be that the child had already told about most of the food requested that mother had bought and when he was questioned on this point could think mostly of the foods mother did not buy.

As will be noted in Table 13, liking the food was the main reason given for wanting these other foods requested. Liking the food was an especially important reason

Table 12.—Kinds of "other" foods requested and which of these his mother bought.*

	Boys		Girls	
Kinds of food	Requested	Mother bought	Requested	Mother bought
	Percent	Percent	Percent	Percent
Main dish, as meat, fish, hot dogs, baked beans	45	17	38	17
Cereals and breads	18	7	13	5
Fruits, vegetables, salads, juices	39	15	21	7
Desserts and candy	27	9	23	9
Snacks, potato chips, peanuts, popcorn	5	2	10	3
Soup	2	1	6	3
Milk products	7	3	0	—
Other, as pickle	2	1	0	—
No report	0	—	2	0

*Adds up to over 100 percent as some children named more than one kind of food.

with boys. In fact, the difference between boys and girls was highly significant. Boys gave it more often than girls.

Appeals Effective With Young Children

Two techniques were used in studying effective appeals with young children. In the first technique the child was shown a photograph of a boy (John) at the cereal counter of a grocery; or if a girl, a picture of a girl (Jane) at the cereal counter. (See the two pictures on the front cover of this bulletin.) He or she was shown the picture and asked what kind of cereal John (Jane) bought and why he (or she) picked out this kind.

In the second technique the child was handed a card with appeals for four kinds of cereals (W, X, Y, and Z). He (or she) was told: "John's (Jane's) mother has told him (her) to choose the cereal he (she) wants. John (Jane) has trouble deciding which kind of cereal to buy." The appeals to boys used in each of the four kinds of cereal were: "For three box tops the company making cereal W will send John a set of pictures of National League baseball players. Cereal X is advertised to contain food values that make strong muscles, helping a boy to become an athlete. Cereal Y, his mother says, is best for boys. John really likes the taste of cereal Z."

The appeals to girls used were: "For three box tops the company making cereal W will send Jane a book on how to make friends and be popular. Cereal X is advertised to contain food values that make a beautiful skin and a good figure. Cereal Y, her mother says, is best for girls. Jane really likes the taste of cereal Z." Boys

Table 13.—Why child wanted mother to buy these "other" foods.

Why wanted*	Boys	Girls
	Percent	Percent
Like it; fixes so good; they're good	120	71
Saw at store	0	8
Saw on TV, looked good in advertisement	5	6
Want for morning recess, snack at school, dinner	7	4
For refreshments, for friends, party, company, for Brownies, Cub Scouts	2	6
Out of it at home	2	2
Good for you, makes strong, lots of vitamins	5	8
Ate at restaurant or friend's house	0	4
Other ('cause Dad wanted; heard about from sister; for quick meal; on special; thought I could fix)	2	6
No reply, just did	2	2

*Some children gave several kinds of foods and a reason for wanting each. Percentages add up to more than 100 percent.

Table 14.—Reasons given by boys and girls for picking out the cereals.

Reasons for picking out*	Boys	Girls
	Percent	Percent
Like it; my favorite	60	63
Healthy; makes grow strong; nourishing	23	20
Habit; because I have them	8	7
Have baseball cards; have football trading cards	6	0
Has corn; corn is good for you	0	3
Has raisins; I like raisins	12	5
Has more sugar; already sweet; can put as much sugar as you want on this kind	2	3
Shape and color of cereal	0	3
What I would buy	0	3
More in box for money	1	1
Saw advertised on TV	0	1
Curiosity; sounds good	0	1
Other (they go with all kinds of fruit, come from Alaska)	2	2
Just would; don't know	1	1

*Some children gave two reasons for choosing a specified kind of cereal.

were asked which cereal John, girls which cereal Jane, would choose.

A total of 27 kinds of ready-prepared cereals was named in connection with the first technique in which the child was asked the kind of cereal John or Jane bought. However, there were only two kinds of cereal named by more than 7 percent of the boys or girls. These were cornflakes and raisin bran. Thirty percent of the boys and 47 percent of the girls mentioned cornflakes. Twenty-eight percent of the boys and 17 percent of the girls mentioned raisin bran.

The reason usually given for picking out the cereal was: Like taste; they look good; I like and believe he or she would; she looks like she would like; they are good; my favorite; most boys and girls like. (Table 14). The second reason in importance was: Healthy; gives energy; good food value; need to be strong; for pep; low in calories; makes grow strong; it's got vitamins; iron and minerals; they are nourishing.

Reasons for picking out raisin bran took third place and included the fact that "it has raisins, I like raisins." Habit took fourth place and included statements such as: I'm used to it; most everyone buys; because I have them; that's what I or we get or have or buy or eat.

The following cereals each with a different appeal were selected by boys and girls:

Cereal and appeal	Boys Percent	Girls Percent
W—For boys: pictures of ball players For girls a book on making friends and being popular	15	3
X—For boys:: food value that makes strong muscles For girls: food value that makes good skin and figure	40	28
Y—Mother says it's best	21	38
Z—Like taste of this cereal	24	31

Cereal X, advertised to contain food values that make strong muscles and help a boy to become an athlete, was the cereal most often chosen for John. Cereal Y, which her mother says is best for girls, was the cereal most often selected for Jane.

This finding would seem to indicate that appeals of food for children should not be directed altogether to the child. What mother says is important, especially to girls. According to a study made by The Ladies Home Journal, including depth interviews with 70 of their subscribers, mothers do not by any means accept and buy the cereal sold to their children on television[4].

Some of the comments made by boys and girls of this study concerning the cereal mother thought best were: He wants to do what his mother wants; Because mother knows better than I do; Her mother knows more about cereals; I always like to do things mother wants me to do; Her mother would know better than her; Most of the time mothers know more about things to eat than children do; Because she's the boss and she's the one to tell you what you should eat; If I pick what I think is best, I'm afraid I would get the wrong kind of food; His mother knows the kinds he needs; Because before I started to like corn flakes mother said the sweet cereal wasn't so good for me. She said I would like cornflakes better and I do; Because you are supposed to do what your mother says; Because her mother would keep telling her it was best and encourage her to get; I like her and wouldn't want to break up our good relations when we like each other so well; Her mother has probably studied it and knows best; She could take her mother's advice 'cause mothers are right and girls wrong about all the time; Mothers know best about children and what they say is what you should do; She knows that her mother knows what's good; Mothers ought to know the needs of children more than children themselves; She looks like she would do what her mother says is best for her.

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[4] Readers Reaction Bureau, Ladies Home Journal, 1961.

In both techniques used in studying effective appeals, health aspects and liking the taste of the product were relatively important. More boys than girls, however, responded to the health appeal in the second technique. Greater response is no doubt related to type of illustrations used. Boys 9 and 10 years are definitely interested in strong muscles and becoming an athlete, but girls at this age are not thinking too much of complexion and figure.

Taste of the product is an appeal that might well be used more often. After all, food is eaten for enjoyment, a fact sometimes overlooked by processors and retailers.

Trading cards, books, or other premiums seem relatively unimportant as an appeal.

The question might well be asked about factors related to appeals. Significant differences were not found in any factors examined except in education and occupation of the father. However, differences approached significance in kinds of appeals and education of mother.

There was a highly significant difference in education of father and in selection of cereal Z (like taste) and of cereal Y (mother thought best). Children of fathers with more education more often chose cereals mother thought best. Children of fathers with less education more often chose cereal which John or Jane really thought tasted best.

Children of managers, clerks and kindred workers more often selected the cereal mother thought was best than children of semi and unskilled laborers. More children of farmers than of managers, clerks, and kindred workers selected health appeals (strong muscles, good complexion and figure). These differences were highly significant.

Summary and Conclusions

It was the purpose of this study to learn (1) where young children hear about foods requested, what foods they request, and whether requests are granted; and if not, why not; and (2) what appeals are effective with children.

The study includes 220 white boys and girls 9 — 10 years of age (120 rural and 100 urban) in Clay and Lowndes Counties, Mississippi. Data were obtained from teachers or from files in the principal's office and from interviews with each child.

When asked about what John and Jane should eat each day, the majority of children named one or more foods in each of the four basic food groups. The percentage naming was, however, higher for urban than for rural children. More children said John and Jane should have these foods than reported that they themselves ate those foods each day. The reason given most often for not eating was "not served", "don't have".

When told that John's or Jane's mother had promised him a dinner party for his birthday and asked for a list of foods to serve, the majority of boys and girls listed one or more foods in each of the four basic groups. Urban children mentioned meat more often than rural children. The child of the more educated mother more often thought his choice would be acceptable than the child of the mother with little schooling.

In both types of tests there seemed to be a keen recognition on the part of children of the importance of foods in the vegetable-fruit group.

The greatest percentage of the children requesting that mother buy or cook specified foods, resulted from television programs, visits to grocery stores with mother, eating the food at homes of friends or relatives or at the school lunchroom and wanting to fix the food themselves (especially girls). Hearing foods advertised over radio and sending off labels or coupons for prizes and premiums was much less important than the other sources.

In about one third of the TV programs the children were correct as to the food advertised on a favorite program. Foods requested varied with the source. In grocery store shopping more children requested cereals and snacks. Foods eaten at the homes of friends and relatives which they wanted mother to prepare were more often meat dishes and desserts. The six types of foods most often requested by young children were: meats or main dishes, fruits and vegetables, cereals, snacks, desserts and bakery products.

Most requests made by children were granted. Reasons given for not satisfying requests differed with foods. Reasons given for refusal to buy foods involving little preparation such as seen at grocery stores included: Have at home; don't need; can't afford; too many sweets. Reasons for refusal to buy foods involving more preparation included: Mother doesn't know how to make; mother doesn't have recipe; doesn't have ingredients.

Appeals found most effective with young children were: (a) Like flavor, taste; (b) Healthy (makes strong muscles. good skin and figure); and (c) Mother says it's best.

From this study it would seem that: (1) Today's children are on the whole well versed in the basic four. They know somewhat more than they can actually put into practice. (2) The child learns about food from many sources and experiences. No one source or experience can do all the work of informing. (3) Requests of child to buy food are usually granted. Children do have a great deal of influence. (4) The child requests every type of food, some foods more under one source or experience than another. This indicates need for varied sources and experiences by the child. (5) The role of mother should not be underestimated. In this study her influence seems to be important to both boys and girls though apparently greater with girls who perhaps identify with the mother more than do the boys.

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Cost And Returns To Producers Of Milk For Manufacturing

As Affected by Volume of Production, Management, and Price

By JAMES G. HAMILL

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COSTS AND RETURNS TO PRODUCERS OF MILK FOR MANUFACTURING AS AFFECTED BY VOLUME OF PRODUCTION, MANAGEMENT, AND PRICE

By JAMES G. HAMILL

Supplies of milk for manufacturing have declined sharply in Mississippi in recent years. Producers furnished a peak supply of over 368 million pounds in 1957. From this peak, producer supplies had decreased 26.6 percent to 270 million pounds by the end of 1962. This rapid decline in supplies has created a problem of much concern to the manufactured milk indutry. Some plants have been closed and other plants are operating at much below capacity.

The decrease in producer supplies is a result of producers leaving the industry. In 1957 there were 15,743 producers in the state. By the end of 1962, the number had decreased 46.0 percent to 8,499. Production per farm has been increasing, but at a rate too slow to maintain supplies. Some of the reasons producers have been leaving the industry are: increased production costs, high beef cattle prices, and retirement or the acceptance by dairy farmers of newly created industrial jobs.

The Problem

The hesitancy in adopting improved management practices to meet changing cost-price relationships has forced many farmers to discontinue their dairy operations. Future supplies of milk for manufacturing depends upon the relative profitability of this enterprise compared to alternative enterprises and alternative employment opportunities. Producer prices will play an important role in enabling producers to combat the "price-cost squeeze" confronting them, but cost problems can be attacked more directly by farmers than can price problems.

Objectives

The objectives of the study were:

1. To describe the present patterns of enterprise combination and resource use found on farms supplying milk for manufacturing.

2. To describe a combination of enterprises giving the most profitable resource use under improved management.

3. To compare net returns to the farm operation under the two situations described above.

4. To estimate the combination of enterprises and resources necessary to achieve specified levels of income with specified milk prices.

Scope and Method

In a 1959 farm survey, the Department of Agricultural Economics, Mississippi Agricultural Experiment Station, obtained estimates of the complete 1958 farm operation from a sample of producers of milk for manufacturing. The sample was drawn from lists of 12,154 producers provided through the courtesy of 17 milk plants and receiving stations. Names on these lists were divided into five groups based on the amount of milk sold during a two-week period in December of 1958. Ranges in pounds sold during the specified period and the number of producers in each group were:

Pounds sold	Number of producers	Group
0	3,398	I
1- 199	7,264	II
1,000-1,999	1,114	III
2,000-2,999	227	IV
3,000 or more	151	V

Groups were numbered I—V in ascending order according to volume sold and a sample of 25 producers was randomly drawn from each group.

Estimates of inputs and outputs for crop, livestock and pasture enterprises were obtained from each producer. Other data collected from each producer consisted of building and equipment inventories, available labor, and management practices. The information collected from this survey was used to construct a typical farm operation for each group.

Two levels of management were considered in the analysis: (1) present management, that is, the level of management being exercised by the farmers at the time of the interview and (2) improved management, a level of management which makes fuller use of known technology. Improved management represents a combination of estimates from professional agricultural workers, farmer experience, and experimental results.

Information from the farm survey was used in constructing enterprise budgets for the present management situation. Enterprise budgets under improved management situations specify the use of production techniques and yield expectations as estimated by the sources indicated above. Average prices for 1958 were used in all the budgets, Appendix Tables 1—9. Linear programming was used to determine the most profitable enterprise combination and resource use for each management-size situation. Production requirements, yields, costs, and returns for the typical farm under both levels of management were taken from the enterprise budgets.

An analysis was made of the effect of price changes on resource requirements for specified levels of income. Price levels used in this analysis were 10 percent below, and 10 and 20 percent above average prices of milk for manufacturing received by Mississippi farmers in 1958.

PRESENT MANAGEMENT

"Typical dairy farms" constructed for each producer group reflects the average size of dairy herd and herd management practices; land utilization and cropping practices; labor availability and utilization; capital investment; and off-farm income reported by producers. This information was used in budget analysis to estimate costs and returns to the farm business as operated in 1958 by the average farmer in each group of producers.

The Dairy Herd

The typical herd varied in size from 9 animal units in Group I with 7 cows being milked during the year to 31.75 animal units in Group V with 26 cows being milked during the year, Table 1.

None of the farms studies kept individual-cow production records, although most producers stated they culled cows from the herd for low production. Other reasons stated for culling cows from the herd were old age and mastitis.

Most of the farmers kept a bull. Little emphasis was placed on the quality of bull. Twenty-two of the 125 farmers interviewed used artificial insemination, some borrowed their neighbors's bull, but the scrub bull predominated. When asked the question "why did you buy that particular bull," the answers ranged from "I wanted to improve my herd and the bull was registered" to "I needed a bull so the cows would drop a calf." None of the farmers kept a breeding record except

Table 1.—Average composition of herd, by size group, 125 dairy farms, Mississippi, 1958.

Animals	Group I	Group II	Group III	Group IV	Group V
	— — — — —		Number	— — — — —	
Cows	7	7	12	18	26
Heifers (1-2 years)	1	2	4	4	6
Heifers (under 1 year)	2	2	4	5	7
Bull	1	1	1	1	1
Total	11	12	21	28	40
Animal units[1]	9.00	9.50	16.00	22.25	31.75

[1] One mature cow or bull; 2 heifers 1-2 years, or 4 heifers under one year.

those who used artificial insemination.

Replacement heifers were raised at the rate of one heifer for each three to four cows. This number would be adequate, but with the general quality of breeding it is doubtful if the replacement animal's capacity for milk production would be any better than, if as good as, that of the dam. Facilities for raising replacements—sheds and stables that had been in use for many years—made sanitation quite a problem and increased the disease hazards.

Annual volume of milk sold per cow, determined by the number of cows reported by producers and milks sales as obtained from manufacturing plant records, varied from less than 1,900 to 4,100 pounds, Table 2.

The amount of concentrates fed per cow varied from 1.09 pounds per pound of milk sold (Group I) to .52 pounds per pound of milk sold (Group V). The typical ration for each group consisted of a mixture of oil seed meal, corn, molasses and salt. The protein content varied from 12.5 percent crude protein for Group IV to 13.1 percent crude protein for Groups II and III.

The amount of stored roughage fed per cow varied from 2,063 pounds for Group II to 3,340 pounds for Group IV. Two major factors probably contributed to the low feeding-rate of hay. Either the hay was rationed, or if fed free choice, it was of such poor quality that low consumption resulted. A majority of the farmers practiced rationed feeding of stored roughage. Only 9 farms in the survey had silage as a part of their stored roughage program. This silage was converted to hay equivalent and included in Table 2 as stored roughage.

The pasture improvement program consisted of some seeding and fertilizing in each group. Producers in each group practiced weed control by clipping. The extent of pasture improvement is shown by comparing the average annual expense per acre of open pasture, which varied from $1.30 per acre for Group I to $3.49 per acre for Group IV.

Resource Use

In 1958, the average producer of milk for manufacturing had a capital investment highly disproportionate to his income earned from farming. Investment in land accounted for approximately 50 percent of total investment for each group, Table 3. Investment in cropping and dairy equipment was next in importance. Building investment per animal unit averaged

Table 2.—Concentrates, stored roughage, pasture, and milk sales per cow, by size group, 125 dairy farms, Mississippi, 1958.

Item	Unit	Group 1	Group II	Group III	Group IV	Group V
Concentrates	cwt.	20.58	23.22	32.42	20.81	20.68
Roughage	cwt.	25.69	20.63	25.62	33.40	30.64
Pasture	acre	7.29	3.29	3.78	2.67	4.59
Milk sales	cwt.	18.81	30.40	40.78	41.05	39.44

Table 3.—Average capital investment, by size group, 125 dairy farms, Mississippi, 1958.

Item	Group I	Group II	Group III	Group IV	Group V
			— — — — — Dollars — — — — —		
Equipment	4,531	3,936	5,041	5,522	7,838
Buildings	2,429	2,577	3,282	5,154	5,006
Land[1]	10,800	7,850	11,550	15,600	22,650
Fences	462	273	447	582	722
Cows[2]	1,475	1,565	2,650	3,680	5,260
Total	19,697	16,201	22,970	30,538	41,476

[1] Land valued at $100 per acre of open land and $50 per acre of other land.

[2] Cows valued at $165, heifers 1-2 at $90, heifers under 1 at $40 and bull at $150.

Table 4.—Land utilization and crop yields, by size groups, 125 dairy farms, Mississippi, 1958.

Land utilization and yield per acre	Group I	Group II	Group III	Group IV	Group V
			Acres		
Land utiliation					
Cotton	4.8	4.9	5.2	5.5	5.2
Corn, grain	15.6	11.3	21.4	25.9	25.0
Temporary winter grazing	4.0	.....	.....	7.4	.....
Pasture	46.3	23.0	35.7	43.3	105.6
Pasture and hay	4.7	.....	9.7	4.7	13.7
Hay crops	13.6	6.8	8.0	15.2	27.5
Idle land	5.0	7.0	6.0	11.0	5.0
Woodland	24.0	48.0	53.0	79.0	81.0
Wasteland	4.0	3.0	6.0	7.0	8.0
Total	122.0	104.0	145.0	199.0	271.0
			Yield per acre		
Cotton (lbs. of lint)	431.3	413.8	544.2	487.0	481.0
Corn, grain (bu.)	36.8	37.8	37.1	40.2	42.3
Pasture and hay (tons)	1.0	.....	1.0	1.8	1.2
Hay crops (tons)	1.1	1.3	1.5	2.1	1.6

about $270 on farms with the smallest herds, but dropped to an average of $158 for the largest dairies.

The average farm ranged from 104 acres Group II) to 271 acres (Group V), Table 4. The cropping program for farms in all groups included cotton, corn, and hay. An average of about 5 acres of cotton was grown on farms of all sizes. Most of the producers surveyed did not provide a temporary winter grazing crop for the dairy herd.

The average family in each group included two adults and one fourteen-year old child. Data presented in Table 5 shows the average amount of family labor available and the pattern of labor utilization for each group in the study. The large amounts of unused family labor — ranging from 1,222 hours in Group V to 3,068 hours in Group I — illustrate the low level of utilization of this resource, particularly in the smaller farm operations. The family labor supply was more than sufficient for the farm operation except during the crop harvesting season when farmers in each group hired labor as needed.

Returns to the Farm Business

The farmer is mainly interested in how much net return he can get from the things he has to earn a living with. . his labor and that of his family, his land, and his other investment capital. The manner in which he manages the resources he has determines the size of this net return.

For the five groups of dairies analyzed, 1958 average annual receipts from farming ranged from $1,990 (Group II) to $6,378 (Group V), Table 6. While average receipts for the largest dairies averaged about 16 percent higher than those for any of the other four groups, expenses on these large farms averaged 51 percent more than on other farms. Operators of the larger dairies, therefore fared worse financially than did those in Group IV, who showed an average net return of $2,206, or those in Group III, with a net return of $1,450. Average net returns for dairies with fewer than eight cows was less than $800 in 1958.

Since the farms did not afford full-time employment for all members of the famly, the typical family earned some income through off-farm work. Income from all sources averaged less than $2,650 for the highest income group, and for one group, incomes averaged less than $1,000 for the year.

Table 5.—Labor: Hours available and utilized, by size groups, 125 dairy farms, Mississippi, 1958.[1]

		Labor utilized				
Item	Family labor available	Group I	Group II	Group III	Group IV	Group V
		— — — — — Hours — — — — —				
1st. puarter:						
Family labor	992					
Field	(272)	29	24	38	48	48
Livestock	(720)	319	359	530	842[2]	790[3]
Total	992	348	383	568	890	838
2nd. quarter:						
Family labor	1,144					
Field	(408)	240	198	283	329	388
Livestock	(736)	235	269	419	538	626
Total	1,144	475	467	702	867	1,014
3rd. quarter:						
Family labor	1,712					
Field	(976)	212	156	231	280	371
Livestock	(736)	230	263	412	508	613
Total	1,712	442	419	643	788	984
4th. quarter:						
Family labor	1,176					
Field	(448)	419	422	569[4]	571[5]	288
Livestock	(728)	272	306	465	583	678
Hired labor	—	130	80	186	230	500
Total	1,176	821	808	1,220	1,384	1,466
Yearly total:						
Family labor	5,024	1,956	1,997	2,947	3,699	3,802
Hired labor	—	130	80	186	230	500
Grand total	5,024	2,806	2,077	3,133	3,929	4,302

[1] Method of estimating available field labor: Man — eight hours per day on days fit for field labor. Child — eight hours per day on days fit for field labor during June, July, and August.

Method of estimating available livestock labor: Man — two hours per day every day of the year. Woman — four hours per day every day of the year. Child — two hours per day every day of the year.

[2] 122 hours of field labor utilized as livestock labor.

[3] 70 hours of field labor utilized as livestock labor.

[4] 121 hours of field labor derived from more hours per family worker than was generally allowed for available family field labor.

[5] 123 hours of field labor derived from more hours per family worker than was generally allowed for available family field labor.

IMPROVED MANAGEMENT

The manager of a farm business must make decisions in two general areas: (1) enterprise selection and combination, determining the kinds and quantities of enterprises to produce; and (2 determining those production practices which will best use his limited resources in producing that enterprise combination. This phase of the study deals primarily with selection of the most profitable enterprise combination for the typical farm in each group, incorporating those production practices that reflect a level of improved management.[1]

The practices evaluated under improved management compose an overall pro-

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[1] See Hamill, J. G. and Simpson, J. H., Jr., An Economic Evaluation of Production of Milk for Manufacturing in Mississippi, (Mississippi Agricultural Experiment Station Bulletin Number 613); State College, Miss., February, 1961, for a description of these practices.

Table 6.—Average income from farm and non-farm sources by size groups, 125 dairy farms, Mississippi, 1958[1].

Item	Group I	Group II	Group III	Group IV	Group V
	— — — — —	— Dollars —	— — — — —		
Receipts:					
Cotton	793	777	1,084	1,026	958
Corn	502	299	466	1,151	630
Hay	247	38	144	238	479
Milk	438	694	1,639	2,483	3,425
Cattle	258	182	476	622	886
Total	2,238	1,990	3,809	5,520	6,378
Expenses:					
Cotton	272	256	355	391	455
Corn	354	235	462	563	548
Hay crops	190	93	125	330	556
Pasture	60	41	99	151	303
Pasture and hay	70		145	69	224
Temporary grazing	53			173	235
Feed purchased	168	139	362	489	546
Cattle purchased				166	652
Depreciation	96	96	122	144	144
Hauling milk and ADA	58	94	215	325	451
Hired labor	47	29	67	83	180
Miscellaneous[2]	250	244	471	430	721
Total	1,523	1,190	2,359	3,314	5,015
Net farm returns:	715	800	1,450	2,206	1,363
Off-farm income:	917	107	1,038	431	342
Total family income	1,632	907	2,488	2,637	1,705

[1] Interest on investment has not been deducted from farm income.

[2] Includes cleaning materials, milking supplies, veterinary costs, electricity, repairs, etc.

Table 7.—Land utilization and crop yields, optimum combination of resources, improved management, by size groups, 125 dairy farms, Mississippi, 1958.

Land utilization and yield per acre	Yield per acre	Group I	Group II	Group III	Group IV	Group V
		— — — — —	— Acres —	— — — — —		
Land utiliation						
Cotton (lbs. of lint)	550.0	4.8	4.9	5.2	5.5	5.2
Corn, grain (bu.)	50.0	15.2	8.7	14.6	19.3	24.2
Millet	—	15.6	8.8	15.0	19.8	24.8
Pasture	—	24.0	13.6	23.0	30.3	38.0
Pasture and hay (tons)	2.5	20.8	11.8	20.0	26.3	33.1
Corn silage (tons)	9.0	9.4	5.3	9.0	11.9	14.9
Idleland	—	4.2	—	—	—	41.8
Woodland	—	24.0	48.0	53.0	79.0	81.0
Wasteland	—	4.0	2.9	5.2	6.9	8.0
Total		122.0	104.0	145.0	199.0	271.0

duction program. Omission of any part of the management program from the farm operation could prevent achieving the level of production and the returns associated with improved management. However, practices other than those considered could be used provided they resulted in comparable returns.

Land

In programming optimum farm organizations, land acreages were held constant to reflect improvements that can be made on existing farms, Table 7. No attempt was made to utilize woodland and wasteland, and pasture land was restricted from being utilized for crops.

Cotton acreages were assumed to represent current allotments, and thus were not changed. The remaining crops were grown in support of the dairy enterprise. The size of the dairy enterprise was limited by the number of acres of cropland or total open land. In Groups I and V some pasture land was left idle for lack of sufficient acres of cropland to support a larger dairy enterprise.

The Dairy Herd

Under improved management, herd size would vary from 23 to over 63 animal units, Table 8. Annual production per cow was estimated at 6,327 pounds, the average of 74 dairy herds on test in the Dairy Herd Improvement Association in Mississippi for 1958. By following the dairy management practices outlined in this study, dairy farmers can readily achieve this production per cow.

Culling and Breeding

A high-producing herd can be developed only by an intensive program of culling and breeding. With an intensive program of culling, those cows which do not have the inherited characteristics for high milk production can be sold from the herd. Then with a well-managed breeding program and/or purchase of high producing animals, replacements will have an increased genetic capability for milk production.

Under improved management, mature cows would not be bred until the third heat period after calving, nor heifers until they attain the proper age and size, which may vary with breed. All breeding would be done by artificial insemination which, at an average fee of five dollars per cow, not only is generally more economical than using a herd bull, but also has other advantages. Artificial insemination facilitates controlled breeding and the keeping of breeding records, both very important in an efficient dairy operation.

A record of production is a prerequisite for determining which cows to keep in the herd. A records program involves not only obtaining scales, weighing the milk and keeping a record, but also using the record as a basis for culling.

Raising Replacement

All heifers would be raised and at least one heifer for each three cows would be retained as a replacement. Sterilizing all utensils used in feeding the calves and using portable pens for shelter would improve sanitation. Results of the calf management program followed at the Pontotoc Ridge-Flatwoods Branch Experiment Station, where 70 calves have been raised with no deaths or serious trouble from disease, evidence the value of these practices.[2]

Stored Roughage Program

Two and one-half tons of hay or hay-equivalent per animal unit would be needed each year and would be fed during those periods when grazing would not provide for nutritional needs. Silage is considered to be an important factor in achieving the milk production set forth for improved management. Three tons of

Table 8.—Size and composition of herd, optimum combination of resources, improved management by size group, 125 dairy farms, Mississippi, 1958.

Animals	Group	Group II	Group III	Group IV	Group V
	— — — — — Number — — — — —				
Cows	31	18	30	40	50
Heifers (1-2 years)	10	6	10	13	17
Heifers (under 1 year)	12	7	12	16	20
Total	53	31	53	69	87
Animal units[1]	39.00	22.75	38.00	50.50	63.50

[1] One mature cow; 2 heifers 1-2 years, or 4 heifers under 1 year.

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[2] Hurt, B. C., Jr., Graham, E. N., and Hamill, J. G., Producing Milk for Manufacturing, (Mississippi Agri. Exp. Station Bulletin 590); State College, Mississippi, February, 1960, pp. 5-7.

good quality silage were considered equivalent to one ton of good quality hay. Silage feeding would be limited to cows in production and fed at the rate of approximately 25 pounds per day when grazing was not available. Corn was the only silage crop considered in this study.[3]

Since coastal bermuda is considered adaptable for most areas of Mississippi, it was the hay crop selected for use on the typical farm under improved management. Its use, of course, would depend on its adaptability in comparison with other crops for any particular farm situation. High-quality hay is a necessity under improved management, and coastal bermuda will produce a high-quality hay if managed properly. Hay would be fed free-choice to the entire herd, preferably through some type of self-feeder, during those periods when grazing is inadequate.

Pasture Program

An intensive pasture program was considered necessary to achieve the production goal of 6,327 pounds of milk per cow. The most important crops in this program are coastal bermuda and crimson clover. This combination will produce the most grazing per acre of all permanent pasture crops considered. The crimson clover will furnish early spring grazing, and when the crimson clover is gone, two cuttings of hay from the coastal bermuda will furnish the necessary hay for the dairy operation, with much additional grazing later. Cutting the coastal bermuda for hay twice would give adequate weed control. The other permanent pasture crop included under improved management was a Dallis grass-white clover combination. For maximum grazing, the permanent pasture must be cross-fenced and a strict program of controlled grazing followed. Weeds should be controlled by spray with 2, 4-D in June. Millet would be used in the summer as a temporary grazing crop, with half of the acreage being planted the first of May and the other half the first of June. This grazing would be utilized only by cows in production, and grazing would be controlled.

Since land capabilities vary, the combination of pasture and forage crops used in the study will not be suitable for every farm situation. Soil-testing and other specialists of the Extension Service can assist the farmer in adjusting to his individual farm conditions.

Concentrate Feeding

The mix suggested for cows in production, under the improved level of management, is 530 pounds of oilseed meal, 1,440 pounds of corn-and-cob meal, and 30 pounds of salt. This mixture provides a 16 percent crude protein ration, which would be fed at the rate of about one pound of feed for each 3 pounds of milk during the winter months and 1 pound of feed for each 4 pounds of milk during the summer months. For winter feeding of dry cows and heifers, a mixture of 280 pounds of oilseed meal, 1,700 pounds of corn-and-cob meal and 20 pounds of salt provides an 11-percent crude protein ration. Dry cows would be fed approximately 5½ pounds of this mixture per day, large heifers about 4 pounds and small heifers about 5 pounds. This ration was developed primarily to utilize homegrown feeds in meeting the nutritional requirements of the dairy herd. The above feeding rates depend upon the availability of good quality roughage.

Capital Requirements

The shift to optimum farm organizations would, of course, require additional capital investment on the part of the operators. Additional investment amounts would range from about $10,000 to $13,000, Tables 3 and 9. Most of this capital increase would be in the form of larger numbers of higher-quality animals, and the forage-handling equipment necessary to maintain these animals. It is estimated that essentially the same amount of equipment would be necessary to maintain herds of all sizes. The use of this equipment plays an important part in achieving the overall management program set forth in this study.

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[3] Research being conducted by the Departments of Agronomy and Dairying, Mississippi Agri. Exp. Station, shows promise for grain sorghum as a silage crop for dairy cattle.

Since the suggested changes require no additional land, investment in that asset would not be changed. Building investment, on the average would be increased by about $700.

Table 9.—Investment capital requirements, optimum combination of resources, improved management, by size groups, 125 dairy farms, Mississippi, 1958.

Investment	Group I	Group II	Group III	Group IV	Group V
	— — — — —	— —	Dollars	— —	— — — — —
Equipment	9,193	9,047	9,184	9,262	9,600
Buildings	3,157	3,277	4,004	5,898	5,773
Land[1]	10,800	7,850	11,550	15,600	22,650
Fences	462	273	447	582	722
Cows[2]	8,900	5,200	8,700	11,550	14,550
Total	32,620	25,929	34,008	42,915	52,957

[1] Land valued at $100 per acre of open land and $50 per acre of other land.
[2] Cows valued at $200, heifers 1-2 at $150 and heifers under 1 at $100.

Table 10.—Labor: Hours available and utilized, optimum combination of resources, improved management, by size groups, 125 dairy farms, Mississippi, 1958[1].

		Labor utilized				
Item	Family labor available	Group I	Group II	Group III	Group IV	Group V
		— — — — —	—	Hours	—	— — — — —
1st. quarter:						
Family labor	992					
Field	(272)	79	47	76	98	122
Livestock	(720)	728	423	705	894	870
Hired labor					46	304
Total	992	807	470	781	1,038	1,296
2nd. quarter:						
Family labor	1,144					
Field	(408)	384	271	384	408	408
Livestock	(736)	605	351	585	736	736
Hired labor					111	385
Total	1,144	989	622	969	1,255	1,529
3rd. quarter:						
Family labor	1,712					
Field	(976)	403	282	399	494	577
Livestock	(736)	455	264	441	588	734
Total	1,712	858	546	840	1,082	1,311
4th. quarter:						
Family labor	1,176					
Field	(448)	448	448	448	448	448
Livestock	(728)	518	301	501	668	728
Hired labor		283	190	315	420	574
Total	1,176	1,249	939	1,264	1,536	1,750
Yearly total:						
Family labor	5,024	2,620	2,387	3,539	4,334	4,623
Hired labor		283	190	315	577	1,263
Grand total		3,903	2,577	3,854	4.911	5,886

[1] Method of estimating available field labor: Man —eight hours per day on days fit for field labor. Child — eight hours per day on days fit for field labor during June, July and August.

Method of estimating available livestock labor: Man — two hours per day every day of the year. Woman — four hours per day every day of the year. Child — two hours per day every day of the year.

Labor

The optimum combinations of resources make for more efficient use of family labor than formerly, Table 10. While on the smaller farms only about half or less of the available family labor supply would be used because of land limitations, even this is an improvement over the extremely low utilization found in the survey. Besides permitting fuller use of family labor, the revised plans call for greater use of hired labor.

In estimating labor utilization, it was assumed that, within a given quarter, labor available for field work could be shifted to livestock but that livestock labor was not transferable to field labor. In a situation where hired labor was not available, the optimum combination of enterprises would change to a combination which would use family labor most efficiently.

Returns to the Farm Business

The adoption of improved management practices would necessitate sharp increases in annual expenditures, but would result in even greater gain in farm returns, Table 11. On the average, for all farms analyzed, current expenditures would rise by about 117 percent, but a 150 percent increase in farm receipts would mean a 214 percent increase over present levels in net returns.

For particular groups of farms, results of the change would be even more striking. For large farms (Group V), it is estimated that the improvements would increase returns from the former level of $1,363 to $5,622 — a 312 percent jump — while current expenses would rise by only 72 percent. Operators of small farms (Group I), who netted an average of only $715 from farming by the old methods, could increase their returns by 441 percent to $3,866.

None of the estimated returns shown in Table 11 includes non-farm income as did the totals in Table 6. Yet in each instance farm returns resulting from improved management are much higher than the combined farm and non-farm income from previous methods. Neither table shows the value of farm perquisites, which, of course, are important components of the farmer's realized net income.

Table 11.—Estimated net farm returns resulting from optimum combination of resources and improved management, by size groups, 125 dairy farms, Mississippi, 1958.

Item	Group I	Group II	Group III	Group IV	Group V
Receipts:			— — — — — Dollars — — — — —		
Cotton	1,011	1,032	1,096	1,159	1,096
Milk	6,649	3,861	6,435	8,580	10,724
Cattle	1,509	876	1,460	1,947	2,434
Total	9,169	5,769	8,991	11,686	14,254
Expenses:[1]					
Cotton	306	312	331	350	331
Corn	427	245	411	543	681
Pasture	390	221	374	493	618
Pasture and hay	645	366	620	815	1,026
Temporary grazing	200	113	192	254	318
Corn for silage	344	194	330	436	546
Feed purchases	1,229	714	1,190	1,586	1,982
Depreciation	184	107	178	238	297
Hauling milk and ADA	824	478	797	1,063	1,328
Hired labor	102	68	113	207	453
Breeding	207	120	200	267	334
Miscellaneous[2]	445	258	431	574	718
Total	5,303	3,196	5,167	6,826	8,632
Net farm returns	3,866	2,573	3,824	4,860	5,622

[1] Expense items do not include a charge for investment .

[2] Includes cleaning materials, milking supplies, veterinary costs, electricity, repairs, etc.

RESOURCE REQUIREMENTS FOR SPECIFIED INCOME LEVELS AT SPECIFIED MILK PRICES

To estimate the effect changes in the price of milk would have on the milk producer, a linear programming technique was used to determine the resource requirements necessary to attain income levels of $2,000, $4,000 and $6,000 net returns to land, labor, capital and management with a price for milk of $3.05, $3.73 and $4.07 per hundredweight. These prices are 10 percent below, and 10 and 20 percent above the 1958 average price received by Mississippi farmers for milk for manufacturing. Prices other than those for milk were held at 1958 levels.

The input coefficients were based on improved management. The available family labor for a family of three was utilized with hired labor available when needed. Each acre of land was brought into the farm organization at fixed proportions of .247 acres of cropland (including .03 acre of cotton allotment), .341 acres of pasture-land and .412 acres of woodland, idleland and wasteland. Land use was restricted to those crops found on the sample farms.

Even at prices for milk 20 percent above those for 1958, the farmer would have to milk 12 cows and produce 2.2 acres of cotton to earn $2,000 annually, Tables 12 and 13. Production yielding this income would require, on the average for Mississippi conditions, a 75-acre farm. To earn a $6,000 net return he would need a 234-acre farm on which he had 39 cows and 7 acres of cotton. For the average family of three, operation of such farm would require about 72 10-hour days of hired labor, Table 14.

Should milk prices drop to $3.05 per hundredweight, or 10 percent below 1958 levels, 21 milk cows and 3.8 acres of cot-

Table 12.—Size and composition of herd necessary to earn specified levels of income at specified levels of milk prices below and above 1958 price, optimum resource combination, improved management, typical dairy farm, Mississippi.

	$2,000			$4,000			$6,000		
Herd size	10% below	10% above	20% above	10% below	10% above	20% above	10% below	10% above	20% above
					Number				
Cows	21	14	12	47	30	25	84	47	39
Heifers (1-2 years)	7	5	4	16	10	9	29	16	13
Heifers (under 1 year)	8	6	5	18	12	10	33	18	15
Total number	36	25	21	81	52	44	146	81	67
Animal units*	26.50	18.00	15.25	59.50	38.00	32.00	106.75	59.50	49.25

*One mature cow; 2 heifers, 1-2 years; or 4 heifers under 1 year.

Table 13.—Land utilization to earn specified levels of income, optimum combination of resources, improved management, specified prices for milk below and above 1958 price, typical dairy farm, Mississippi.

	$2,000			$4,000			$6,000		
Item	10% below	10% above	20% above	10% below	10% above	20% above	10% below	10% above	20% above
					Acres				
Cotton	3.6	2.6	2.2	8.5	5.3	4.6	15.2	8.4	7.0
Corn for grain	10.4	7.1	6.1	23.1	14.6	12.5	41.6	23.1	19.2
Millet	10.7	7.3	6.3	23.8	15.0	12.9	42.7	23.7	19.7
Pasture	16.4	11.1	9.6	36.3	22.9	19.6	65.3	36.2	30.1
Pasture and hay	14.3	9.7	8.4	31.6	19.9	17.1	56.9	31.6	26.3
Corn and silage	6.4	4.4	3.8	14.3	9.0	7.7	25.7	14.2	11.9
Other land[1]	65.2	45.3	38.7	144.3	91.1	78.8	259.3	144.0	119.8
Total	127.2	87.5	75.1	281.9	177.8	153.2	506.7	281.2	234.0

[1] Includes idleland, woodland, and wasteland.

Table 14.—Labor, available and utilized, optimum combination of resources, improved management specified income levels, specified prices for milk below and above 1958 price, typical dairy farm, Mississippi.

	Family	$2,000			$4,000			$6,000		
	labor available	10% below	10% above	20% above	10% below	10% above	20% above	10% below	10% above	20% above
		— — — — — Hours — — — — —								
1st. quarter:										
Family labor	992									
Field	(272)	55	37	32	121	76	66	217	121	101
Livestock	(720)	496	336	291	871	693	594	775	871	891
Hired labor					228			1,200	225	21
Total	992	551	373	323	1,220	769	660	2,192	1,217	1,013
2nd. quarter:										
Family labor	1,144									
Field	(408)	277	188	163	408	387	332	408	408	408
Livestock	(736)	411	279	241	736	575	493	736	736	736
Hired labor					382			1,599	379	123
Total	1,144	688	467	404	1,526	962	825	2,743	1,523	1,267
3rd. quarter:										
Family labor	1,712									
Field	(976)	288	196	169	639	403	346	976	637	530
Livestock	(736)	310	210	182	687	433	372	736	685	570
Hired labor								671		
Total	1,712	598	406	351	1,326	836	718	2,383	1,322	1,100
4th. quarter:										
Family labor	1,176									
Field	(448)	448	377	327	448	448	448	448	448	448
Livestock	(728)	352	239	207	728	492	423	728	728	649
Hired labor		107			837	328	218	2,441	831	574
Total	1,176	907	616	534	2,013	1,268	1,089	3,617	2,007	1,671
Yearly total:										
family labor	5,024	2,637	1,862	1,612	4,638	3,507	3,074	5,024	4,634	4,333
Hired labor		107			1,447	328	218	5,911	1,435	718
Grand total		2,744	1,862	1,612	6,085	3,835	3,292	10,935	6,069	5,051

Table 15.—Investment capital necessary to earn specified levels of income when milk prices are at specified levels below and above 1958 price, optimum combination of resources, improved management, typical dairy farm, Mississippi.

	$2,000			$4,000			$6,000		
Investment	10% below	10% above	20% above	10% below	10% above	20% above	10% below	10% above	20% above
Equipment	8,881	8,725	8,680	9,464	9,083	8,971	10,293	9,464	9,285
Buildings	2,156	1,437	1,232	4,825	3,080	2,567	8,623	4,825	4,004
Land	9,540	6,562	5,632	21,142	13,335	11,490	38,002	21,090	17,550
Fences	655	451	387	1,452	916	789	2,610	1,448	1,205
Cows	6,050	4,150	3,500	13,600	8,700	7,350	24,450	13,600	11,250
Pasture	78	52	45	174	111	93	312	174	145
Total	27,360	21,377	19,476	50,657	35,225	31,260	84,290	50,601	43,439

ton would be needed to earn $2,000 above current operating expenses. At these low prices for milk it would take a minimum of 84 milking cows and 15.2 acres of cotton for the farmer to earn a $6,000 return to his labor, management and capital investment. An operation of that size would require more than 500 acres of land.

From none of these income figures has a deduction been made for interest on capital invested. Farm investments for each of the nine price-income level situations analyzed range from $19,500 to $84,000, Table 15. Deducting a 5 percent charge for interest on investment would leave the operator's family very little cash for living expenses. The $2,000 earnings could be cut to as low as 926, Table 16. Even under the best price situation considered, the man who cleared $6,000 above current operating costs would have less than $4,200 left after deducting the charge for use of the capital invested.

Table 16.—Returns to labor and management, optimum combination of resources, improved management, specified income level, specified prices for milk below and above 1958 price, typical dairy farm, Mississippi.

	$2,000			$4,000			$6,000		
Item	10% below	10% above	20% above	10% below	10% above	20% above	10% below	10% above	20% above
Receipts:									
Cotton	804	546	473	1,782	1,123	964	3,203	1,777	1,479
Milk	4,072	3,379	3,196	9,026	6,959	6,517	16,222	11,010	9,999
Cattle	1,027	697	604	2,277	1,435	1,232	4,091	2,271	1,890
Total	5,903	4,622	4,273	13,085	9,517	8,713	23,516	15,058	13,368
Expenses:									
Cotton	243	165	143	539	340	291	968	537	447
Concentrate	1,020	692	600	2,261	1,425	1,223	4,064	2,255	1,877
Calf starter	240	163	141	532	335	288	956	530	441
Milk for calves	162	110	95	358	226	194	644	357	297
Pasture	264	179	155	586	369	317	1,053	585	486
Pasture and hay	438	297	258	971	612	525	1,745	969	806
Temporary grazing	135	92	80	300	189	162	539	299	249
Corn for silage	232	157	136	514	324	278	924	513	427
Breeding	141	96	83	312	197	169	561	311	259
Depreciation on fences, bldgs., and equip.	125	85	74	278	175	151	499	277	231
Hauling milk and ADA	561	380	330	1,243	784	673	2,234	1,240	1,032
Miscellaneous	303	206	178	672	423	364	1,207	670	558
Hired labor	39			519	118	78	2,122	515	258
Total	3,903	2,622	2,273	9,085	5,517	4,713	17,516	9,058	7,368
Total net returns to land, family labor, investment, capital & management	2,000	2,000	2,000	4,000	4,000	4,000	6,000	6,000	6,000
Interest on average investment (5%)	1,074	802	715	2.135	1,431	1,252	3,669	2,132	1,806
Net returns to family labor and management	926	1,198	1,285	1,865	2,569	2,748	2,331	3,868	4,194

SUMMARY AND CONCLUSIONS

The sharp decline in the supply of milk for manufacturing has caused much concern within the industry. Increases in the volume of "Grade A" surplus milk have failed to offset the decline in volume supplied by producers of manufacturing milk. Some of the more important factors leading to the decline in production by producers of manufacturing milk have been: increased production costs, high beef cattle prices, the low price of milk for manufacturing relative to the price of "Grade A" milk, and retirement of the acceptance of off-farm employment by dairy farmers.

Present management practices and enterprise combinations on manufacturing milk farms yield low returns. Even before allowing for interest on investment, the typical farm in two of the five size-groups studied showed returns of $800 or less in

1958. Average earning of capital, labor and management for the remaining size-groups ranged from $1,450 to $2,200.

Linear programming techniques were used to evaluate the effect of milk prices, improved management practices and resource availability upon farm organization and income. At 1958 prices, optimum farm organizations with improved management practices would have increased returns to the factors of production on the typical farms by as much as 120 to 440 percent.

To achieve returns to capital, labor and management of $2,000, $4,000 and $6,000, it would be necessary to have an investment of $27,000, $51,000 and $84,000 if the 1958 milk price is allowed to decrease by 10 percent (from $3.39 to $3.05 per cwt). If the 1958 milk price is increased by 10 percent (from $3.39 to $3.73 per cwt). an investment of $21,000, $35,000 and $51,000 would be required to achieve the specified returns to capital, labor and management. With a 20 percent increase in the 1958 milk price (from $3.39 to $4.07 per cwt). an investment of $19,000, $31,000 and $43,000 would be necessary to achieve the specified income levels. With the highest price and income level an investment of $43,000 would be required to yield a return of $4,194 per year to labor and management.

Incomes higher than those presently received can be attained through better management, more efficient use of labor and land, and additional capital expenditures. The individual must compare his present or expected returns with alternative enterprises and alternative employment opportunities.

APPENDIX

Appendix Table 1.—Estimated costs and returns per cow, improved management, typical dairy farm, Mississippi, 1958

Item	Unit	Quantity	Price	Amount
	(38 cow milking herd)		Dollars	Dollars
Income:				
Milk	cwt.	63.27	3.39	214.49
Cattle sold				48.67
Total				263.16
Expenses:				
Concentrate	cwt.	23.58	2.05	48.34
Calf starter	cwt.	.98	11.60	11.37
Milk for calves	cwt.	2.26	3.39	7.66
Pasture	acre	.77	16.27	12.53
Pasture and hay	acre	.67	30.99	20.76
Temporary grazing	acre	.50	12.82	6.41
Corn for silage	acre	.30	36.63	10.99
Breeding				6.67
Depreciation on fences, bldgs., and equip.				5.94
Hauling milk and ADA				26.57
Miscellaneous[1]				14.36
Total				171.60
Net returns above specified expenses				91.56

[1]Miscellaneous includes cleaning and other dairy supplies, veterinary costs, electricity, repairs, etc.

Appendix Table 2.—Corn: Estimated costs and returns per acre, improved management, typical dairy farm, Mississippi, 1958

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Income:				
Corn	bu.	50.0	1.14	57.00
Expenses:				
Seed	bu.	.2	10.38	2.08
Ammonium nitrate	cwt.	3.0	3.80	11.40
Superphosphate	cwt.	2.0	1.55	3.10
Muriate of potash	cwt.	.5	2.62	1.31
Tractor operation	hr.	8.75	.95	8.31
Equipment operation	acre	1.0	. .	1.92
Total expenses				28.12
Returns above specified expenses				28:88

Appendix Table 3.—Cotton: Estimated costs and returns per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Income:				
Cotton lint	lb.	550.0	.3410	187.55
Cottonseed[1]	lb.	971.1	.02385	23.16
Total				210.71
Expenses:				
Seed	cwt.	.75	11.50	8.62
Ammonium nitrate	cwt.	2.18	3.80	8.28
Superphosphate	cwt.	2.40	1.55	3.72
Muriate of potash	cwt.	.80	2.62	2.10
Insecticide	acres	1.0	-----.-----	11.05
Tractor operation	hours	9.35	.95	8.88
Equipment operation	acres	1.0	-----.-----	5.21
Ginning, bagging and ties	cwt.-lint	5.50	2.70	14.85
Miscellaneous	acres	1.0	-----.-----	1.00
Total expense				63.71
Returns above specified expenses[2]				147.00

[1] Trash per bale = 3.3 percent of the harvested seed cotton weight (1,573 pounds), or 51.9 pounds of trash.

[2] No charge made for hired labor.

Appendix Table 4.—White clover and Dallisgrass pasture: Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Dallisgrass seed[1]	lb.	1.0	.80	.80
White clover seed[2]	lb.	.2	.834	.17
Ammonium nitrate	cwt.	1.0	3.80	3.80
Superphosphate	cwt.	3.0	1.55	4.65
Muriate of potash	cwt.	1.0	2.62	2.62
Lime[3]	ton	.4	7.25	2.90
Tractor operation	hours	1.2	.95	1.14
Equipment operation	acres	1.0	----.-- -	.19
Total annual expense				16.27

[1] Prorated for 10 year life, 10 lbs. at $.80/lb.

[2] Prorated for 10 year life, 2 lbs. at $.834/lb.

[3] Two tone per acre every 5 years, custom application at $2/acre.

Appendix Table 5.—Coastal bermuda and Crimson clover for grazing and hay: Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Bermuda sprigs[1]	thous.	.25	.60	.15
Crimson clover[2]	lb.	6.0	.325	1.95
Ammonium nitrate	cwt.	2.0	3.80	7.60
Superphosphate	cwt.	3.0	1.55	4.65
Muriate of potash	cwt.	1.33	2.62	3.48
Lime[3]	ton	.4	7.25	2.90
Tractor operation	hours	7.04	.95	6.69
Equipment operation	acres	1.0	-------	3.57
Total annual expenses[4]				30.99

[1] Prorated over 20 year life, 5,000 sprigs at $.60/thousand.

[2] Prorated over 5 year life, 30 lbs. of seed at $32.50/cwt.

[3] Two tone per acre every 5 years, custom application at $2/acre.

[4] Includes cost of harvesting 2½ tons of hay per acre.

Appendix Table 6.—Millet: Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Seed	lb.	25.0	.09	2.25
Ammonium nitrate	cwt.	2.0	3.80	7.60
Tractor operation	hours	2.5	.95	2.38
Equipment operation		1.0	. ..	.59
Total annual expense				12.82

Appendix Table 7.—Corn silage: Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Seed	bu.	.3	10.38	3.11
Ammonium nitrate	cwt.	3.0	3.80	11.40
Superphosphate	cwt.	2.0	1.55	3.10
Muriate of potash	cwt.	.5	2.62	1.31
Tractor operation	hours	11.35	.95	10.78
Equipment operation	acres	1.0	------	6.93
Total annual expenses[1]				36.63

[1] Includes cost of harvesting 9 tons per acre.

Appendix Table 8.—Estimated quarterly labor requirements for farm operation, typical dairy farm, Mississippi, 1958

	1st quarter	2nd quarter	3rd quarter	4th quarter	Total
	— — — — — Hours — — — — — (38 cow milking herd)				
Livestock labor (per cow):					
Feed hay	1.53	.26	....	.50	2.29
Milk	11.47	12.42	8.97	8.21	41.07
Clean	1.55	1.61	1.61	1.58	6.35
Feed grain	1.42	1.55	1.13	1.03	5.13
Other routine work	1.21	1.24	1.24	1.24	4.93
Calves in pens	1.74	.97	.21	.97	3.89
Rotate grazing	....	.24	.71	.	.95
Feed grinding	.61	.32	.21	.24	1.38
Fence repair	1.82	. .	....	1.82	3.64
Feed silage	1.53	.26	. .	.50	2.29
Miscellaneous	.61	.63	.61	.61	2.46
Total	23.49	19.50	14.69	16.70	74.38
Field labor (per acre):					
White clover and dallisgrass	.24	.58	.98	.10	1.90
Coastal bermuda and crimson clover	1.56	4.09	5.14	.19	10.98
Millet	....	1.76	2.23	.	3.99
Corn silage	1.38	5.86	7.93	.26	15.43
Corn	1.35	5.82	2.84	15.24	25.25
Cotton	1.41	24.06	24.69	102.34	152.50
Total	5.94	42.17	43.81	118.13	210.05

*1st. quarter, December, January, and February; 2nd. quarter, March, April, and May; 3rd quarter, June, July, and August, 4th quarter, September, October, and November.

Appendix Table 9.—Investment capital, present and optimum combination resources, improved management, typical dairy farm, Mississippi, 1958.

Item	38 cow milking herd
	— — Dollars — —
Equipment:	
Tractor, 2-row	2,640
Breaking plow	--------
Stalk-cutter, 2-row	500
Disk, 6' - 8'	485
Middlebreaker, 2-row	200
Fertilizer distributor, 10'	325
Fertilizer distributor, 2-row	75
Section harrow, 2-section	45
Cultivator, 2-row	285
Planter, 2-row	230
Trailer	465
Rake, side-delivery	485
Baler, small-PTO	1,750
Cultipacker, 10'	365
Spraying equipment	121
Cotton duster, hand	45
Mower, 7'	395
2-unit milking machine	260
Milk cooler, 7 can	220
Milk cans	221
Miscellaneous	150
Total	9,262
Buildings:	
Barn, hay storage and feeding	2,986
Milking barn	500
Trench silo	267
Other buildings	148
Total	3,901
Cattle:	
Milk cows	7,600
Heifers, (1-2 years)	1,950
Heifers, (under 1 year)	1,500
Bull	------
Total	11,050
Other:	
Land	13,388
Fences	920
Pasture	141
Total	14,449
Total investment	38,662

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A Case Study in

Trade-Area Development

Changes in Occupation and Social Organization in a Northeast Mississippi County

MISSISSIPPI STATE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

HENRY H. LEVECK, Director

STATE COLLEGE MISSISSIPPI

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SUMMARY

This is a case study of community development — planned change in a limited locality. The focus is on shifts in the labor force, changes in rural social organization and institutions, and the nature of development organization. It is an interpretive report based on intensive studies in Alcorn County in Northeast Mississippi. The findings of 26 published reports listed in the appendix, together with unpublished data, provided the basis for analysis.

As the number of workers in agriculture declined, population, organizations, and services moved from the open country to the trade center, Corinth, which in 1963 had an estimated one-half of the county's population. The decades 1940-1960 showed a rapid shift out of agriculture into manufacturing, trades, and services. Family income increased appreciably, and radical changes occurred in the farm enterprise. The increase in the number of rural women gainfully employed had a favorable impact on rural income and level of living.

Families in the open country varied considerably in terms of social and economic characteristics, and thus were analyzed on the basis of the different kinds of development programs needed. Several types of families were delineated. There were those supported entirely from nonwork income, those still receiving all or part of their income from agriculture, and those rural residents living in the open country who received no agricultural income. The nonwork income type, which consisted chiefly of the older retired families, was relatively homogeneous. Families receiving income from agriculture consisted of two widely divergent types of farm operators, the modern commercial farmer and the traditional, small farmer. Rural residents were highly heterogeneous in nature — on the one hand, the unskilled part-time worker of low income and socio-economic level, and on the other, the "elite" of the countryside.

With the transition from an agricultural economy with small farmers to an industrialized one massed around an urban center, radical changes occurred in schools churches, and rural services. Although open-country neighborhoods had lost services over the last several decades, community club programs provided strength in some places. By 1963, open country club organization had reached a plateau with its future appearing to depend on both occupational shifts and county-wide organizational strategy and effectiveness. Data indicated that it was in the strong neighborhoods with a long history of activity at the neighborhood level that community development clubs were likely to succeed rather than in the weaker neighborhoods where development organization might seem to offer a last hope for neighborhood survival.

At the county level two strong centers of development in terms of interest, organization, and leadership existed. One was the complex of agricultural organizations in which the Agricultural Extension Service played a prominent role. There were approximately a score of different types of agricultural agencies and membership organizations at the county level and more than fifty neighborhood units.

A second center of development in terms of organization and leadership was the business-industrial complex in which the Corinth Chamber of Commerce played a prominent role. During the decade 1952-1962 the area was especially fortunate to have both paid and voluntary workers of high ability in both agricultural and business activities. During this period a number of significant projects were inaugurated and some completed, such as the creation of an industrial park, the planning and financing of a 2.8 million dollar hospital, the construction of a commercial airport, and the extension of telephone service to many residents in the southern portion of the county.

Overall planning and coordination were carried out through an informal liaison between the two major leadership groups — the agricultural and the business-industrial — rather than through one centralized agency.

A Case Study in Trade-Area Development Changes in Occupation and Social Organization in a Northeast Mississippi County

By HAROLD F. KAUFMAN and LUCY W. COLE

PROBLEM AND PROCEDURES

This report is a case study in community development. Community development focuses on the process of planned change in a limited locality. In this instance it is a county seat in Northeast Mississippi with its surrounding trade area. The emphasis is on development organization and programs and their interrelation with changes in the occupational structure and local institutions.

Economic Development

The study of development activity is a multi-disciplinary task with economic concerns frequently receiving the major attention. Generally considered as the best single indices of economic development are per capita increases in real income and in output.

Increasing attention is being paid to the process of development in both highly industrialized nations and underdeveloped countries; the latter have some similarities with the former but also conditions uniquely their own[1]. In the United States, the South, especially the rural South, has received special attention in development of the economy and in improving the relatively serious, low-income situation.

The first pronounced interest in facilitating adjustments of low-income families in rural areas developed during the depression of the thirties. There has been a re-emphasis since World War II[2]. Compared to high-income regions, low-income areas usually have limited agricultural resources, heavy farm population, and insufficient nonfarm employment opportunities. Approximately 1,000 counties in the nation, most of them in the South, have been identified as low-income counties[3]. All the counties in Mississippi have been classified as low-income, and only those in the Delta and on the Gulf Coast are not listed in the "serious" category.

A number of studies have been done within the last decade dealing with economic adjustment of families in low-income areas. These studies have focused on labor utilization, resource use, and level of living of families[4]. With the rapid shift of workers out of agriculture, the low-income situation of the South is changing primarily from a concern in the economics of agriculture to a focus on the complex of problems dealing with the development of the total economy and society.

In promoting economic development, knowledge of what might be termed the "little" economies appears to be essential.

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[1] The literature in the general field of rapid social and economic change is already voluminous and continues to grow. A journal such as **"Economic Development and Culture Change,"** published quarterly by the Research Center in Economic Development and Culture Change of the University of Chicago, would give the reader some notion of the scope and amount of work in this field.

[2] **Development of Agriculture's Human Resources,** U. S. Department of Agriculture, Washington, D.C., April 1955.

[3] **Ibid.**

[4] Agencies of the U. S. Department of Agriculture and state experiment stations have carried on cooperative studies in a number of places. See Buis T. Inman and John H. Southern, **Opportunities for Economic Development in Low Production Farm Areas,** Agricultural Information Bul. 234, USDA, November 1960.

Until recently, however, this area of research has been largely overlooked[5]. A recent survey of the "little" economies in the United States found over 14,000 privately and publicly financed organizations concerned with local economic development. It was also discoverd that "single purpose programs, such as industrial development, are beginning to be replaced[6] by multi-purpose, comprehensive programs." It is within this context of local economic development that the present study of development organization and related social factors may be most timely and useful. To complement the traditional economic analysis, which includes the balance or imbalance[7] of productive fact tors such as capital, resources and technology[8], it is proposed that the notion of development organization be added as an essential part of the study of local development[9].

Organization for Local Development

The objective of this study is to analyze, at least in a preliminary fashion, selected organizational factors in the local development complex. Of central concern is the development organization itself, such as a community development or area improvement agency. Closely associated with the above is a group of auxiliary agencies serving clientele with special interests and technical needs. These agencies in the locality studied include the Agricultural Extension Service and USDA agencies with county programs.

A second concern of this study is a description of changes in organizations which represent the basic social institutions, such as the church and school, and which are essential in providing social stability and continuity. These might be termed agencies of the "community of residence," and data on them are presented in the section on "Changing neighborhoods."

A third body of data deals with the labor force. This includes an analysis of changes in occupation and of classification of family types useful for development programs. Presented first in the report, however, as necessary background for describing the development organization, are population and geographic data.

Activities in the county trade area reported here are to be seen as a case study of the community development movement in the South, which has been prominent since World War II[10]. Programs are generally organized on a trade center or county basis and frequently have both open-country neighborhood and regional counterparts. Although they emphasize creation of new jobs and income, they are broad in purpose and have a number of objectives. In Mississippi at the present time there are a score or more of counties with development organizations such as those described in this report.

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[5] See Donald R. Gilmore, **Developing the "Little" Economies,** Committee for Economic Development, Supplementary Paper No. 10, 1959. See also the work of the group of researchers affiliated with the Regional Science Association.

[6] **Ibid.**, p. 24.

[7] For development of a theory of unbalanced growth sequence see Albert D. Hirschman, **The Strategy of Economic Development,** Yale University Press, 1958.

[8] See **A Blue Print For Mississippi Economic Progress** sponsored by the Mississippi Economic Council and released in November, 1962. This consists of a summary statement and of more than a score of "background papers" describing what are termed "income stations" and "income conditioners." To the three factors, resources, capital, and technology are frequently added population and economic and political institutions. The notion of development organization as treated here is, at best, a residual category, largely implicit in most writings.

[9] Although beyond the scope of this study, the need should be noted for a coverage of theory of development organization and notions of production factors as they apply to the "little" economies—town and country trade areas and cities.

[10] Harold F. Kaufman, **et al., Community Development Programs in the Southeast,** Social Science Research Center Community Series 9, 1956.

Major opportunities for the employment of persons leaving agriculture may reside in centers such as the one described in this study. As one analyst notes, centers up to 50,000 population "make up small city America and probably furnish the bulk of employment opportunities to rural people."[11] In the 1950-60 decade population centers from 10,000 to 50,000 grew much more rapidly than the nation as a whole. In Mississippi many towns even in the 1000 to 2500 class[12] had a comparatively rapid growth, which is an indicator of the rapid increase in non-farm employment.

Labor Force Analysis

Analysis of labor force composition and trends and of sources of employment may provide a crucial link between a study of development organization and the factors in physical production. This type of interpretation is attempted in this report. Persons who engage in production are also to be seen as participants in development programs.

Change in the occupational distribution is frequently used as a measure of development. In this process the relatively large agricultural labor force declines, the proportion in manufacturing at first increases rapidly then levels off, and the percent in trades, services, and professions continues to grow[13]. For example, in the South for the 70-year period, 1890-1960, the proportion of workers in agriculture and mining declined from approximately two-thirds to one-sixth, while the proportion in the professions, commerce, and services increased from one-fourth to over three-fifths, and the proportion in manufacturing, from one-tenth to approximately one-fifth.

In the nation as a whole the proportion in manufacturing has leveled off, while in Mississippi, with a much smaller industrial base, this proportion continues to increase as the percent of workers in agriculture declines rapidly. With the change in occupational types and the decline in the relative position of agriculture in the economy, it is generally observed that the real per capita income increases[14].

An Interpretive Approach

The approaches and problems noted above indicated a report of some scope. An interpretive report is attempted in order to bring together data from several field studies conducted in Alcorn County, Mississippi, for the period 1955-60[15].

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[11] John H. Southern, "Implications of Population and Occupational Change for Rural Areas Development," p. 13, distributed by Economic Research Service, USDA, and given at 40th Annual Agricultural Outlook Conference, November, 1962.

[12] See Harold F. Kaufman and Lucy W. Cole, **Size of Trade Center and Development Programs,** Mississippi Agricultural Experiment Station Bul. 618, April 1961, and George L. Wilber and Ellen S. Bryant, **Growth of Mississippi Counties and Cities, 1950 to 1960,** Mississippi Agricultural Experiment Station Bul. 608, December 1960.

[13] See Colin Clark, **Conditions of Economic Progress,** London: Macmillan, 1940. This author states, "Careful generalization of the available facts indicates that the most important concomitant of economic progress is the movement of the working population from agriculture to manufacture, and then from manufacture to commerce and services."

[14] **Ibid.**

[15] Investigation was also conducted for a short period the summer of 1963. The work has been done by the Department of Sociology and Rural Life, Mississippi Agricultural Experiment Station. The Agricultural Relations Division of the Tennessee Valley Authority provided cooperation on certain phases of the study. In addition to the authors of this bulletin, W. C. Bailey, Andrew W. Baird, and Ellen Bryant were active in the study during much of its history. The first named person had general supervision of the work for several years. Other professional persons associated with it for a shorter period of time were F. D. Alexander, H. A. Aurback, R. M. Bobbitt, G. V. Douglas, J. E. Dunkelberger, A. A. Fanelli, W. M. Gillis, A. Ostric, H. A. Pendersen, and L. J. Silverman.

Earlier publications, which are listed below, as well as previously unpublished data, are utilized.

This report is aptly described as secondary analysis in that the interpretive framework and data used for evidence have been determined after the field work was completed. No attempt is made to carry out an analysis of a tight cause-effect pattern, but rather to reconstruct a loose association through time between shifts in occupational composition on the one hand, and development and neighborhood organization on the other. This relationship suggests the interpretive thread of the bulletin. Sizable bodies of field data which at first might appear as disparate have been brought together and provide significant evidence to support the interpretation.

From the standpoint of an historical and trends perspective, the analysis is limited by lack of data on early time periods. A panel design, however, was employed for a sample of the farm population, information being obtained on the same population for 1954 and 1957.

Full references of 26 selected publications on Alcorn County Studies are to be found in the last section of this report. They may be identified by matching the numerals in parentheses in the text with those in the Appendix. Generalizations in this report are based on extensive statistical materials which are not reproduced in this publication. They are to be found in a statistical supplement entitled **A Case Study in Trade Area Development, A Statistical Supplement**[16].

Ten of the 26 publications focus on the educational and other processes involved in the adoption of agricultural and homemaking practices; ten are concerned with neighborhood characteristics, neighborhood development clubs, and related organizations; and the remaining six deal with a description of family types, occupational mobility, and other relevant topics.

Research Procedures

The data used have been taken largely from sample surveys of the open-country population. Thirty-seven white[17], open-country and hamlet neighborhoods were delineated by an experienced analyst in 1955. An enumeration of households by occupation of the head was made at that time. Over 3,500 households were reported.

A note on the rationale of the original surveys is in order. Three family surveys were made involving two separate but overlapping field work designs. Three data complexes were also pointed up. These were (1) adoption of agricultural and homemaking practices, (2) community club functions and neighborhood structure, and (3) open-country family characteristics and types.

In the first survey in 1955, the schedule on "Adoption of Agricultural Practices" was taken on 161 farm operators[18] in six neighborhoods. A resurvey of these farm operators was conducted in 1958.

In the second survey, conducted in the late spring of 1956, a schedule on "Part-time Farmer and Rural Resident," which focused on occupational and level of living changes, was taken on 482 households in 15 different neighborhoods. In this survey nine neighborhoods were added to the six which had been utilized in the adoption of practices survey.

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[16] Progress Report in Sociology and Rural Life No. 30, August 1963. This may be secured by writing to the Department of Sociology and Rural Life or to one of the authors.

[17] Less than one-tenth of the open-country population was Negro. This population was found widely scattered in 13 of the 37 white neighborhoods and in one small all-Negro neighborhood.

[18] Farmers included in this study had at least five acres of crop land, worked on the farm at least one third of the time, (approximately 100 days), lived on the farm in 1954, owned work power, and made their own decisions on enterprise. Schedules were taken in 1955 covering the 1954 crop year and the resurvey in 1958 covered the 1957 crop year.

A random sample of households in the 15 neighborhoods was secured by interviewing every third household in the nine neighborhoods in which contact had not been made previously. In the six neighborhoods in which the adoption of practices schedules had been taken, every third household was also drawn, but in case the household had already been interviewed, a second interview was not held. The one-third sample of households in 15 neighborhoods resulted in 487 household schedules. All occupational types of households were interviewed. These included full-time farm households as well as part-time farm and rural resident ones, although the schedule had the title designating only the latter two groupings.

The neighborhoods themselves were selected on a purposive basis. The six neighborhoods in the adoption of practices sample were selected by first classifying all neighborhoods as large, medium and small in terms of number of families. Then within each size group, two neighborhoods were selected, one which had a community club and one which did not[19]. The level of agricultural practice in the neighborhoods was also a consideration in the selection.

In selecting the nine additional neighborhoods several factors were considered. First, the neighborhoods to be selected were to be seen in relation to the six which were already being studied. Criteria made explicit in selecting the additional nine neighborhoods were (1) location in the county and distance from the county seat, (2) number of households, (3) occupational distribution, (4) land type, and (5) degree of neighborhood organization. The sample of neighborhoods and families when classified as to size of neighborhood and soil type corresponded very closely to the proportions found in the county as a whole.

The representativeness of Alcorn County of the northeast hill area of Mississippi and of the upland region of the South is noted in the following section.

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[19] A community club did not exist in either of the two smallest neighborhoods, although one was organized in one of them later. The latter neighborhood was selected as one of a pair for this reason.

PLACE AND PEOPLE

This section provides a brief discussion of human and physical resources as background for consideration of labor force shifts and the role of development organization. Physical resources include location, land, and man-made physical property such as buildings, roads, and machinery. The term human resources refers to the population — its characteristics and changes.

Location and Land

Alcorn County, bordering on the Tennessee line and one county removed from the Alabama line, is located in the hill section of Northeast Mississippi. The county is crossed by four railroads and two federal highways. All of these arteries of transportation cross at Corinth, the major trade center and the county seat. In addition to Corinth the county has one small incorporated town, Rienzi, and several unincorporated hamlets. See Figure 1.

The county can be divided into three distinct land use areas. The eastern and western portions are similar and consist of the poorer, more hilly land, much of which is best suited to timber. A third area running north and south through the center of the county

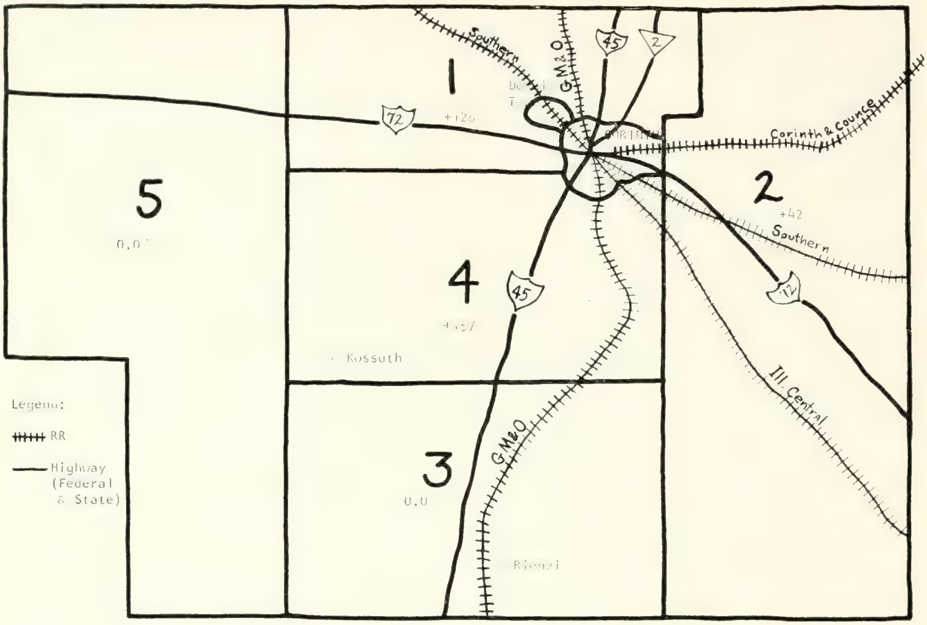

Figure 1.—Alcorn County, Mississippi, Population Centers, Arteries of Transportation, and Percent Population Change by Beat, 1880-1960.

is relatively more level with more of the land suitable for agriculture. The county seat is located at the northern end of this belt. Agriculturally the county is an upland cotton area; this crop still provides a majority of the cash farm income although livestock production is gaining in importance. Certainly over half, and some estimates are as high as four-fifths, of land in the county is better suited for timber than agricultural uses, especially row crops.

Alcorn County is characteristic of the state and the upland South with respect to its major social institutions and traditional agricultural economy with cotton the chief source of cash income. The slow development of industry before World War II with an emphasis on textiles is also typical. Although many counties have one dominant center, as is Corinth, this center is probably larger than the average (median) for the region and certainly for Mississippi. In 1960 one-fifth of Mississippi counties had population centers of 10,000 or over.

Alcorn County was organized in 1870 from parts of the county on the east and the one on the west. It is divided, as are other Mississippi counties, into five beats (administrative townships). See Figure 1.

Centralization in the Trade Center

The shift in population and economic and other activities from the open country neighborhoods and hamlets to the larger centers is a general trend not only in the state and the South but throughout town and country America. This parallels the much greater population shift nationally from town and country to metropolitan areas. The population change is of course an index of the shift in jobs from farm to factory and service establishment.

This radical shift in the location of population and settlement patterns raises important questions concerning work and residence and the relation of the trade center to its hinterland. A central question, which is discussed below, is under what conditions and to what extent the open country can hold and attract persons no longer engaged in agriculture. This assumes that their jobs are located in or near the larger centers of the area.

The proportion that Corinth comprised of the county population increased from approximately one-seventh in 1880 to upward of one-half in 1960. See Table 1. The number of persons outside of Corinth reached its maximum in 1940 and declined sharply in the following twenty years, especially in the 1950-60 decade. In 1960 the population in the open country was about the same as a half century earlier. The analysis of changes in the population by beat locates the shifts geographically. The beats least influenced by activities in the larger trade center had about the same population in 1960 as 80 years earlier when first settlement was under way. See Figure 1.

As is typical, new residences and industries have located in the areas surrounding Corinth. The growth of the center has come not through increase in density of population but by annexation of suburban territory. The entire increase in population in Corinth for the decade 1950-60 was acquired in this manner.

Population Characteristics and Change

Characteristics of the population to be noted are race, age, education, and income. These are compared with state and national averages, and their significance for the adjustment process — the shift of workers out of agriculture —is observed.[20] As is seen in Table 1, the proportion of the population non-white declined from nearly one-third of the total in 1880 to less than one-seventh in 1960. As this racial group has been located entirely in the better farming area in the central portion of the county and in Corinth, the decline in numbers is largely a reflection of the reduction in agricultural workers. The nonwhite population in 1960 was approximately 30 percent less than that in 1940.

The percent nonwhite in 1960 was less than one-third of that for the state but slightly higher than the proportion for the nation. This situation and trend with respect to the nonwhite population is typical of the upland town and country South.

The age distribution of a population may provide some indication of the stage of the adjustment process. A pop-

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[20] Figures for county totals and for state and nation were taken from the **U. S. Census of Population.**

Table 1.—Population of Alcorn County classified by residence and race for selected years, 1870-1960[1].

	Number of Residents			Percent of Residents	
Year	County total	Corinth	Non-White	Corinth	Non-White
1870	10,431	1,512	2,768	14	27
1880	14,272	2,275	4,409	16	31
1890	13,115	2,111	3,510	16	27
1900	14,987	3,661	3,825	24	26
1910	18,159	5,020	4,275	28	24
1920	21,369	5,498	4,106	26	19
1930	23,653	6,220	4,130	26	17
1940	26,969	7,818	4,723	29	18
1950	27,158	9,785	3,904	36	14
1960	25,282	11,453	3,337	45	13

[1]Source: **U. S. Census of Population.**

It is estimated that the population of Corinth increased over 1500 for the period 1960-1963.

ulation that has relatively few jobs for its workers is likely to have a lower proportion of persons in the productive age group — 15 to 64 years of age — than is the population which has adequate employment. The age groups, 0-14 and 65 and over, are frequently termed the dependent ages, and the proportion these age groups form of the total population is sometimes called the dependency rate or ratio.

This rate is appreciably different for the white and the nonwhite group in that the latter has a much higher proportion of the population in the dependent ages. This indicates that the nonwhite population has a much higher outmigration of persons in the productive ages. In 1950 the percent of white persons in the dependent ages was approximately 3 percent higher for Alcorn County than for the nation. Because of the rapid decline in the proportion of persons over 65, however, the dependency rate for the county in 1960 was one percent lower than the national rate. This similarity is an indication of adjustment in the white labor force. However, the nonwhite population in the county continued to have a 4 to 5 percent higher proportion of persons in the dependent age groups than was true for the nation.

In both income and educational level the county ranked slightly below the state and decidely below the nation. In 1960 the median years of schooling completed for persons 25 years of age and over was 8.3 in the county, 8.9 in the state and 10.6 in the nation. The median family income in the county in 1959 was approximately half that of the nation and slightly below that of the state.

As great differences existed within the county with respect to population characteristics as between the county and outside populations. Data collected in a 1956 survey of one-third of the families in 15 of the open-country neighborhoods in the county point up this differential. As was noted above, that portion of the county farthest from the county seat, and with the smallest proportion of agricultural land, had lost population rapidly in the previous twenty years and in 1960 had no more residents than in 1880. The neighborhoods in this portion of the county were more likely to have an older population, one with less schooling, with much lower family income and with a much higher proportion of the population on nonwork income, principally welfare and pension payments. In 1956, for example, in a neighborhood in a declining area of the county 47 percent of the male heads were over 55 years of age. The median years of school completed for persons over 25 was 5.3, and the median family income reported was approximately $600. By contrast, in one of the open-country neighborhoods adjoining the county seat only 29 percent of the male heads were over 55, the median years of schooling completed was 8.5 and the median family income reported was approximately $2300. The declining neighborhoods had a relatively high percent of the population who were supported entirely from nonwork income. In one neighborhood nearly one-third of the households had no work income.

OCCUPATIONAL CHANGES

The focus of this study is an examination of the relations between changes in occupational patterns and in social organization, especially developmental activity. What effect, for example, has the rapid decline in employment in agriculture had on group life, especially in the open country? Changes in occupational patterns are described in some detail in this section.

From Agriculture to Manufacturing

The changes in major occupational

Table 2.—Persons Employed in Agriculture, Manufacturing, and Wholesale and Retail Trade in Alcorn County, Mississippi, 1940-1960[1].

Year	Total No. employed	Agriculture	Manufacturing	Wholesale & retail trade	Other[2]
1960	8,606	17	28	18	37
1950	8,839	34	17	17	32
1940	8,208	43	16	13	28

[1] Source: **U. S. Census of Population.**

[2] Includes service in public administration, the professions, business and finance, transportation and communication, utilities, education, religion, hospitals, health and welfare, entertainment and recreation, repair, and work in private households together with all personal services.

groupings for the 20-year period, 1940-60, are shown in Table 2. For this period the number gainfully employed remained relatively constant; the number in agriculture declined by approximately 60 percent and the number in manufacturing increased three-fourths. The increase in workers in trade, services, business and the professions was moderate. Occupational shifts were especially rapid in the 1950 decade and appeared to be continuing at this pace at the time of writing of this report in 1963. Estimates of jobs added by the establishment of new factories and the expansion of existing ones for the period, 1960-63, indicated that not only the number of workers in manufacturing for 1963 was considerably higher than three years earlier but also the proportion.

An open-country population, which as late as the thirties was made up largely of farm families, was rapidly disappearing. In its place was to be found a population comprised largely of rural residents — persons who lived in the country but whose livelihood was from sources other than agriculture. Of the 482 families reporting income in the 15-community sample survey of 1956, the percents receiving income from the following sources were:

Nonfarm work only	36
Farming and nonfarm work	28
Farming only	22
Nonwork income only	14

It is quite likely that at the date of writing this report in 1963 the proportion receiving income from agriculture only was still decreasing and the reverse was true for the proportion receiving all of their income outside of agriculture.

Process of Shifting Out of Agriculture

Evidence of a shift out of agriculture may be seen also in terms of the trend in number of farms. The year of enumeration and the number of farms reported were as follows:

1900	1944
1930	3334
1950	3050
1954	2498
1959	1888

The number of farms reached the peak in 1930, had a slight decline in the next two decades, and showed a very sharp decrease during the 1950's.[21]

Part-time farming is widely regarded as a transitional stage, either into or out of agriculture, especially the latter. In Alcorn County in 1960, 30 percent of the farm operators reported working 100 days or more off their farms. This was approximately twice the proportion reporting off-farm work two decades earlier.[22] By contrast, for this period the South and the nation showed a reverse trend.

The six-neighborhood survey for the crop years 1954 and 1957 details the process of the shift out of agriculture. (6)

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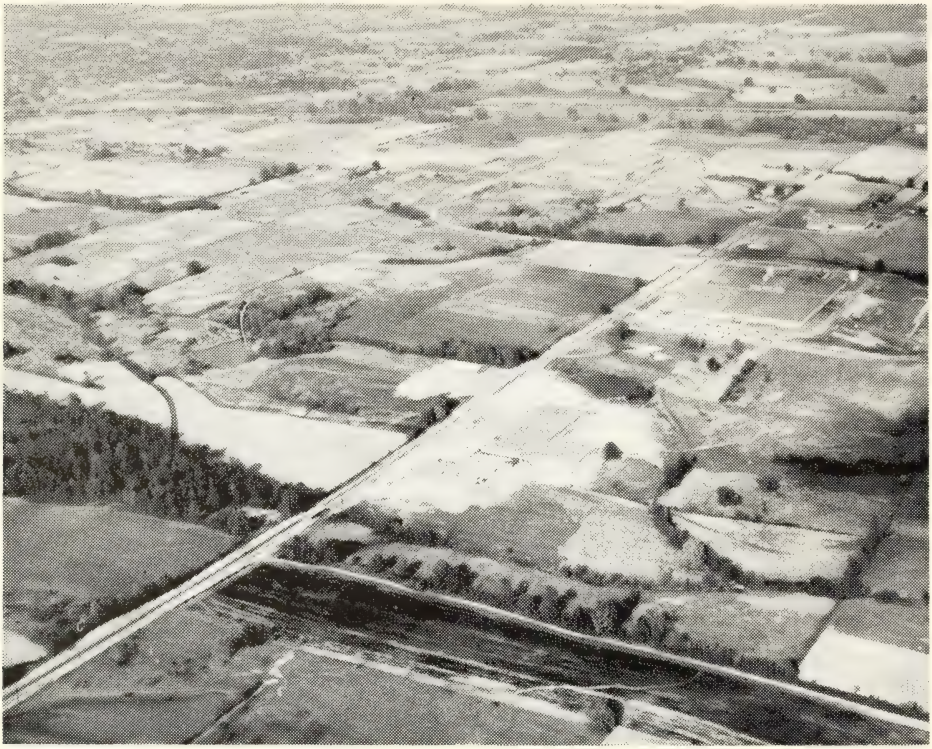
[21] The decrease from 1954 to 1959 is appreciable even when changes in definition of farm are taken into consideration.

[22] **U. S. Census of Agriculture.**



From Farm to Factory: Industrial Park Near Corinth.

Of the 161 farm operators[23] enumerated in these neighborhoods for the crop year 1954, only 109 were left three years later. Thus the decline in number of operators was 52 or approximately one-third in the three-year period. Those who moved had the following status in 1957:

Obtained non-farm employment	29
Retired	15
Moved to a farm elsewhere	8

Of the 29 persons who had quit farming, two-thirds had not moved. Only one of the retired persons had moved from the place where he had been living three years earlier. This relatively large proportion of operators retiring is to be partially explained by the enactment of Social Security legislation for farmers during this period. The great majority of persons taking nonfarm employment stated that the major reason for the change was to make more money.

Persons leaving agriculture were more likely to live in the poor farming neighborhoods located farther from the trade center than were those who remained in agriculture. Those entering nonfarm employment were younger than those remaining in farming, their level of practice was lower, and their operation smaller. Analysis of the use of approximately 1500 acres of cropland operated by the 52 persons who had left farming in the three-year period indicates that the poorer cropland had either gone into the soil bank or remained idle, while much of the better land had been utilized by neighboring farmers. Although the total acreage of crop land had declined, it was probably more productive.

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[23] Farm operators were defined in this study as having at least five acres of cropland, working on the farm at least one-third of the time (approximately 100 days), living on the farm in 1954, owning work power, and making their own decisions on enterprise.

Changes in the Agricultural Enterprise

With the decrease in the number of farms, the median size of farms increased. A major loss in number of farms came from the smaller ones. The average size farm in 1880 was 120 acres. Size declined until 1930, when the average was 60 acres. From then it increased until 1959, when the average was 95.

With the decline in the number of smaller and less productive farms, income rose. The proportion of commercial farms with sales of $5000 or more increased from 1 percent of the total in 1950 to 14 percent in 1959. The reverse was true of those commercial farms with less than $2500 gross sales, which formed nearly nine-tenths of the total in 1950 but only about one-half in 1959. As indicated above, the number of part-time and residential farms continued to increase. The proportion was slightly over one-third in 1950 and increased to nearly one-half by 1959.

Trends in tenure paralleled those found in the nation, region, and state. For the period of record the percent of operators who were tenants gradually increased until 1930, when it formed 59 percent of the total. In 1959, the percent of tenants was 31, only about one-half the proportion found two decades earlier.

Although livestock sales were becoming a more important part of agricultural income, cotton remained the major source of cash farm income.[24] Even with a steady increase in the number of cattle and hogs for the 1940 and 1950 decades and a declining cotton acreage, upward to three-fourths of the cash farm income in 1959 came from cotton. Although the acres devoted to cotton in 1959 were only approximately one-third of those used in 1930, the total production was almost as great due to the fact that yield per acre almost tripled.

Some Aspects of Industrialization

The early industries consisted of saw mills, food processing plants, brick kilns, hosiery mills and a garment plant. Apparel and related plants have continued to be a major source of employment in the county. Between 1954 and 1956 three new shirt factories and a new hosiery mill added close to 700 new jobs.[25] During the latter part of the 1950's two relatively large factories were established producing pianos and telephone equipment. These provided approximately 800 jobs, many for men.

With the large apparel industry it is not surprising that over one-third of all gainful workers in 1960 were women. Of the women in the labor force approximately two-thirds were married, and more than one-fifth of these had children under six years of age. For the 20-year period, 1940-1960, the number of employed women increased by approximately two-fifths, and the proportion women formed of the total labor force increased from 27 to 36 percent. As the percent of employed women living in Corinth remained the same for the period, the increase came entirely in rural areas.

The percent of rural women employed increasel from 13 to 26 percent during the two decades. Significantly, this increase in rural women working came in the period when the number of farms and farmers was rapidly declining. Further implications concerning the rural homemaker who works are discussed in the following section on family types.

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[24] **Base Book of Mississippi Agriculture,** Miss. Crop and Livestock Reporting Service, Jackson, Miss.

[25] See the following publications by the Miss. Agricultural and Industrial Board, Jackson, Miss.:**Directory of Mississippi Manufacturers, 3rd** Ed., 1953, and **Supplement to 1953 Directory of Mississippi Manufacturers — Plants Located Since 1953** (Mimeo.) Jan. 1956.

Effect on Income

The shift of a relatively large proportion of the population out of agriculture into other types of employment contributed appreciably to raising the income level of the county's population. Median earnings of all males in 1959 were $2150.[26] Those in manufacturing and related work reported a median income aproximately three times that of those in agriculture.

Although the median family income in the county in 1959 was reported to be only about half that of the nation, it had much more than doubled during the preceding ten years. In 1959 it was a decidedly higher percentage of the national median than 10 years earlier. This trend was the same as that observed in the state.

An indication of money which the population had available for consumption and investment is to be seen in the index of bank debits.[27] With an index number of 100 in 1945, the amount of funds in the Corinth banks on time and demand deposits had increased to an index of 173 in 1950, and to one of 333 in 1960.

Related to this index is to be seen the sharp increase in industrial payrolls reported by the Corinth Chamber of Commerce. For the period, 1952-62, this item increased from $5½ million to $13½ million. Other indicators of the rise in level of living also reported were the increased number of rural telephones and users of electricity. In 1952 there were only 3,000 rural telephones, and by 1952 the number had more than doubled (6,113). During the same period the number of users of electricity in the county rose from 6,561 to 9,126, an increase of approximately two-fifths. These increases are to be seen in relation to a declining total population.

FAMILY TYPES AND FAMILY LIVING

An analysis of family types moves from a look at the labor force and other factors in production to a concern for the types of people who participate and are served by development organizations. The population, even in the open country, is quite varied, and thus has different needs and demands a variety of services. For educational and action agencies to render the most effective service, some functional classification of families[28] and individuals is necessary.

The Process of Upward Mobility

The process of upward mobility, as the term is used here, is the movement from a given occupation and level of living to a more desirable one for those concerned. The aspect of social mobility which has been described above is the occupational shift from small farm, low-income agriculture to more remunerative nonagricultural employment. Upward movement of job and income is also desirable for many persons in nonagricultural pursuits.

The sample survey of families in fifteen neighborhoods in 1956 provides the data for the two types of classifications used here. The one is determined by source and amount of income and points up level of living groups. The other is determined by level of practice in agriculture and is suggestive of the nature of mobility in this occupational grouping.

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[26] **U. S. Census of Population.**

[27] Compiled by the Bureau of Business and Economic Research, Miss. State Univ.

[28] Harold F. Kaufman and John E. Dunkelberger, "Classifying Families in Low-income Rural Areas," **Sociologia,** Vol. XXII, No. 2, June, 1960.

Table 3.—Relation of Source and Amount of Income to Selected Socio-Economic Characteristics of Families in Alcorn County, Fifteen-Neighborhood Survey, 1956. (22)

		Percent with					
				Head			
Source and amount of income types	Number of families	High socio-economic score[1]	Daily news-paper	Under 55 years	12 or more yrs. sch.	Partici-pation in organ-izations[2]	Wife employed
Nonwork: All incomes	66	18	30	15	5	4	6
Nonfarm: Under $1500	46	26	27	58	5	5	30
Part-farm: Under $1500	43	28	47	58	9	8	23
Farm: All Incomes	124	34	40	62	7	9	..
Nonfarm: Under $4000	86	63	50	88	22	16	38
Part-farm: $1500 & over	72	66	63	82	18	24	55
Nonfarm: $4000 & over	38	87	79	84	40	27	42
All families	475	45	46	64	16	13	24

[1] William H. Sewell, **The Construction and Standardization of a Scale for the Measurement of the Socio-Economic Status of Oklahoma Farm Families.** Stillwater, Okla.: Oklahoma Agr. & Mech. College Agr. Exp. Sta. Technical Bul. No. 9, Apr. 1940. Scores ranged from 39-91; those 72 and above were designated as "high".

[2] Membership in other than religious organizations.

Source and Level of Income

Table 3 shows families classified by source and amount of income and described in terms of selected characteristics such as level of living score, participation in other than religious programs, age of head, and years of schooling (22). The sources of income for the survey families (not head) were classified as to nonwork, nonfarm, farm only, and farm and non farm, which is termed in the table "part-farm." In the 1956 survey almost all families reporting only nonwork income and those reporting only farm income stated that their total cash income was less than $1500. Thus these groups are not sub-classified in terms of amount of cash income received, whereas the part-farm and nonfarm are so classified.

The groups are presented in an ascending order from a low to a relatively high level. The basis for comparison is to be found in the percents for the total sample population. For illustrative purposes the lowest and highest ranking groups may be described. The nonwork income group is to be seen as one of older families, many of them probably retired. Years of schooling, level of living, amount of participation, and percent of wives working were all low. This group comprised approximately one-seventh of all the families. By contrast, the group of families living entirely on nonfarm income and having total annual cash earnings of $4000 or more ranked highest on all the measures used. This group comprised approximately one-twelfth of all families. The significance of these groups for development organization is noted below.

Level of Agricultural Practice

In slightly more than two-fifths of the families surveyed in 1956 — 213 out of 485 — the head was engaged in agriculture either full or part time. These farmers were classified as to how well they followed recommended agricultural practices (26). A level of practice score was computed.[29] Two types of farm operators are treated in this discussion: (1) those with the highest level of practice, adopting all five recommended methods, and (2) those with the lowest level of practice, adopting none, or at the most, one of the recommended pro-

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[29] Five out of 12 practices were selected by the cumulative method of scoring. These were use of certified cottonseed, use of hybrid seed corn, thick spacing of corn, soil testing, and written records.

From Subsistence to Commercial Agriculture — An Improved Dairy Herd.

cedures.

These two groups are compared and contrasted on selected socio-economic characteristics in Table 4. The two groups suggest two types of farm operators found in the present rapidly changing agricultural scene. The highest adopter represents the modern commercial farmer, while the low adopter has the characteristics of the traditional operator who was the dominant type in the area up until a decade or two ago. The high adopter as compared with the low adopter had a much greater gross income, was more likely to have someone in his family in nonfarm employment, was more highly educated, was considerably younger, and was much more active in development and agricultural organizations.

The Employed Wife

Approximately one-fourth of the wives in the survey of the 15 open-country neighborhoods were employed outside the home. These working homemakers had a higher level of adoption of recommended home practices than did those homemakers who were not employed (9).[30] The higher score for those employed may be partially explained by the age and education of those persons and the fact that they were likely to have husbands who were employed and had contacts off the farm. The employed wives were more likely to be in the middle age groups, 35 to 60, than were women not working outside the home.

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[30] Thirteen homemaking practices were used in the index. For details see (9).

Highly significant was the fact that the employed wife contributed approximately one-half of the family's total cash income (9).[31] Partially because of this, those families with employed homemakers were likely to have considerably higher incomes than the other families. It should be noted that the three highest income groups in Table 3 had the highest porportion of wives employed.

It is sometimes maintained that working wives slow up the shift out of agriculture by allowing the husband to remain in farming instead of securing other employment. Certainly, the evidence from Alcorn County does not support this position. Families with heads entirely in nonfarm employment or only part-time in agriculture were much more likely to have homemakers employed than were those where the head received all his income from the sale of farm products. The data from this study suggest that far from the working wife "subsidizing" a partially or totally unemployed husband she is much more likely to have a husband who is "more aspiring" and has higher income than others.

Family Types and Development Organization

From the above analysis several types of families relevant for development programs are indicated. Perhaps the most homogeneous group was those who were supported entirely by non-work income. Most of the heads of these families were retired. Families supported entirely from non-work income comprised approximately one-seventh of the rural population surveyed in 1956. It is likely that the relative size of this group will be maintained for some time because of the high age of many farm operators. Programs most relevant for this group would be those which provide services for the older population of a health, welfare, and educational nature.

A second grouping, those toward which most adjustment programs have been oriented, are the persons who still receive all or part of their income from agriculture. Two types of farm operators and families were noted in Table 4 below and were characterized as the modern

Table 4.—Farmers with the highest and lowest level of practice compared on selected social and economic characteristics. (26)

Item	All operators	Practice level[1] Highest	Lowest
Number of persons	213	18	72
Median gross farm income	$1333	$2600	$1058
Median net family income	$ 728	$2000	$ 423
Percent families receiving income outside of agriculture	57	72	45
Percent of operators full time farming	77	72	79
Percent owning tractor	63	94	44
Median acres operated	72	100	68
Percent with nine or more years of schooling	21	61	4
Median age	49	43	54
Socio-Economic Score[2]	70	82	65
Percent belonging to organizations other than the church	20	50	4
Percent having contact with Soil Conservation Service	22	58	4
Percent having contact with Extension Service	36	75	12

[1] Highest all five practices; lowest, none or one.

[2] Sewell **op. cit.**

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[31] The median income for all families with wives working was $2650; the median income for wives was $1375.

commercial farmer and the traditional small farm operator. Data are not available to predict the exact number of commercial farms with adequate resources that the county can support, but it is likely that the number is considerably less than the 990 commercial farms in the county in 1959. Adequate educational and action programs appear to be available in the county for the full-time commercial farmer. With the growing number of rural residents and part-time farmers, however, programs especially oriented for these persons need to be considered.

A third population of great importance in planning rural development is made up of rural residents—those who live in the open country but are not engaged in farming. This is the largest group in the countryside and is growing in size. As indicated in Table 3, it is quite diverse. It is made up on the one hand largely of unskilled, part-time workers who have relatively low income and socio-economic level, and on the other hand, by a group of rural residents who in terms of level of living, education and organizational leadership may be considered the "elite" of the countryside.

With the rapid decline of the farm population, the open-country neighborhood is becoming more and more a place of residence rather than a location for work. This implication is developed in the following section dealing with rural neighborhoods.

CHANGING NEIGHBORHOODS

Open-country and hamlet neighborhoods.[32] provide at least a part of the locale for rural development. The central question is what contribution, if any, neighborhood organization can make. In this section the neighborhoods in the county are described in terms of services provided and other characteristics; in the following section neighborhood development organization is critically analyzed.

Location and Characteristics

The rural neighborhood has undergone radical change with the transition from an agricultural economy with small farm operators living and working on dispersed farmsteads to an industrialized one with population massed around an urban center and rural residents commuting to this center for work in trades and services. Before changes for the Alcorn County neighborhoods are detailed, however, a brief description is presented of a survey of them in the mid-fifties (1).

As pointed out above, 37 all or predominately white neighborhoods[33] and one non-white neighborhood were delineated in 1955. The neighborhoods varied greatly as to size and other characteristics. In size they ranged from 21 to 295 families, and the median number was 74. The neighborhoods of the county classified as to degree of organization are shown in Figure 2. The nature of neighborhood organization will be discussed in detail in the following section, but it should be noted that a neighborhood is a social unit to the extent that certain activities conducted within its boundaries contribute to its identity. These ac-

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[32] Following its technical usage in sociology the term "neighborhood" is employed rather than the term "community" which is the popular or folk term. Communities and community clubs of Alcorn County are used to designate neighborhoods and neighborhood associations.

[33] One or more Negro families lived in only 14, or slightly more than one-third of the 37 neighborhoods. These were in the central portion of the county.

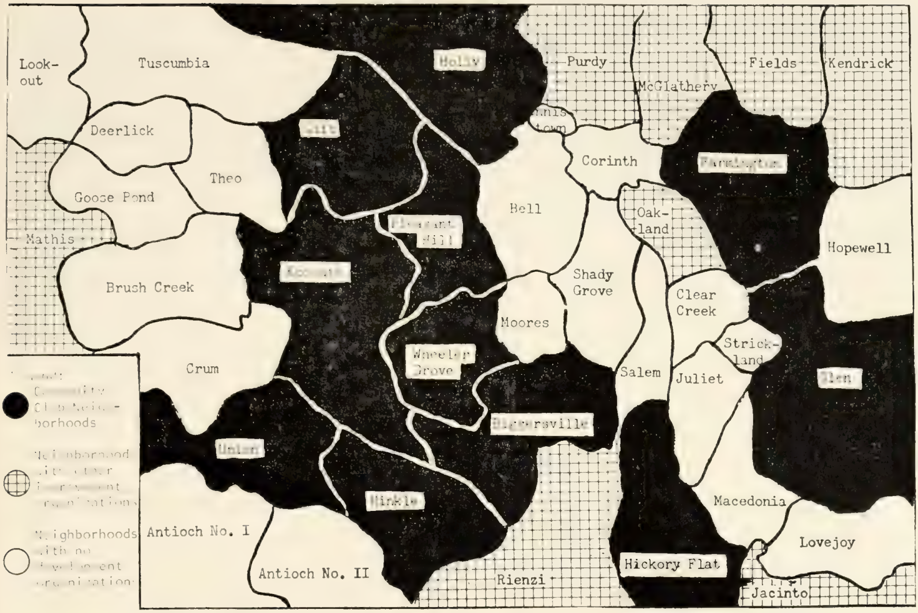
Look-out
Tuscumbia
Holly
Purdy
McGlathery
Fields
Kendrick
Deerlick
nis town
Corinth
Farmington
Theo
Goose Pond
Bell
Pleasant Hill
Oak-land
Mathis
Hopewell
Kossuth
Brush Creek
Shady Grove
Clear Creek
Moores
Strick-land
Wheeler Grove
Crum
Salem
Juliet
Glen
Biggersville
Union
Macedonia
Hinkle
Antioch No. I
Lovejoy
Antioch No. II
Hickory Flat
Rienzi
Jacinto
Legend:
Community Club Neighborhoods
Neighborhood with other improvement organizations
Neighborhoods with no development organizations

Figure 2.—Alcorn County Rural Neighborhoods, 1955-1958, by Type of Organization for Development.

tivities include not only organized efforts but also "neighboring" and informal leisure time pursuits.

In the mid-fifties approximately one-third of the neighborhoods had community clubs, and about the same proportion were utilized as Agricultural Conservation and Stablization units. Over two-fifths were used as voting precincts, and one-fifth had Home Demonstration Clubs. The number of stores, cotton gins and related services had declined, but the exact figures were not available. In 1911, 10 of the neighborhoods had post offices as compared to only four in the mid-fifties. During the last several decades the number of voting precincts increased and remained organized along neighborhood lines.

Consolidation of Schools

Since neighborhoods often grew up around schools, the loss of these institutions explains some of the decline in number of neighborhoods and also the changes in boundaries. Minutes of county school boards for the early decades of the century indicated that the schools were thought of as being neighborhood institutions. These minutes contained many references to petitions for establishment of schools and adjustment of school boundaries. In 1910 there were 71 white elementary schools outside of Corinth (17). At this time school districts and neighborhoods apparently coincided.

The early consolidations seemed to indicate the joining together of neighborhoods or parts of neighborhoods. By 1925 there were only 53 school districts in the county, and according to newspaper accounts, the school names were still the same as the neighborhood names. By 1955 there were only 23 rural elementary schools and three high schools for the 37 rural neighborhoods, and school districts no longer corresponded to neighborhood boundaries. By the sixties the divorcement of school district from neighborhood boundary was complete. There was one district for Corinth and another for the rural areas with eight attendance units. All Negroes were transported to Corinth. The loss of the school as an important neighborhood service not only reduced the number of local functions but also necessitated the forming of new relationships with other neighborhoods and with the county as a whole.

Churches Maintain Their Numbers

By contrast with school trends, the number of churches in the rural area of the county increased. In 1957 all of the 37 neighborhoods except four had churches. There were 64 churches in the rural area of the county as compared with 55 nearly four decades earlier. From 1920 to 1940 there was a gain in the rural population but a loss in the number of churches (19). From 1940 to 1957, however, population declined by one-fifth, but during roughly the same period, 1942 to 1957, the number of churches increased 31 percent. These counter-trends may be illustrated by the seven survey neighborhoods in beats losing population. In the last two census decades two of these neighborhoods gained in number of churches, four retained the same number, and only one lost a church. The village of Rienzi, which lost 6 percent of its population between 1930 and 1950, gained two churches.

In 1957, 29 of the 64 churches were Baptist, 13 were Methodist, 11 were Church of Christ or Christian, and 3 were Presbyterian. Eight were either non-denominational or smaller religious bodies in terms of their representation in the area and the state; all of these eight churches had been organized since 1921. For the period, 1921 to 1957, the number of Baptist churches remained almost the same. The number of Methodist and Presbyterian Churches declined. The number of Churches of Christ increased.

Although many of the schools bore the neighborhood name, a church had the neighborhood name in only one of the 37 localities studied. As contrasted with most other activities, church service areas were for the most part not coterminous with neighborhood boundaries. Slightly more families attended church outside than inside the neighborhood in which they resided.

The Future of the Open-Country Neighborhood

The decline of open-country neighborhoods throughout the nation over the last several decades is well recognized and documented.[34] Although the rural neighborhood has probably been stronger in the South than elsewhere, at least in recent decades, the decline appears to be appreciable here also.[35] In 1910 approximately 70 school neighborhoods were found; in the thirties and forties 45 or 46 neighborhoods were mapped by agricultural workers; and in 1955 in this study only 37 were delineated, some of which were nominal with no organized activity on a neighborhood basis and many residents appearing to be unaware of the name.

The complexity of a neighborhood, the number of services offered, should not be taken as an index of its vitality. The importance of an activity in maintaining locality identity rather than the number

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[34] A number of critical discussions are available. Cf. Alvin L. Bertrand "Rural Locality Groups," **Rural Sociology** 19, pp. 174-179, June, 1954, and Allen B. Edwards, "Ecological Patterns of American Rural Communities," **Rural Sociology,** Vol. 12, pp. 150-161, June, 1947.

[35] Selz C. Mayo and Robert M. Bobbitt, **Rural Reorganization: A Restudy of Locality Groups in Wake County, North Carolina,** N. C. AES Tech. Bul. No. 95, Sept., 1951, p. 24.

The Open-Country Neighborhood a Good Place to Live a Community Club Dinner Meeting

of such activities is the significant criterion in judging the vitality of the neighborhood. For example, some neighborhoods adjacent to the county seat with a relatively large number of services offered to the population were declining as distinctive social units just as were some of the smaller neighborhoods distant from the county seat which were losing population rapidly and which had lost all or nearly all of their services.

The central question in planning is whether or not certain services can be more effectively organized on a neighborhood basis than in some other way. With the decline in the population engaged in agriculture the neighborhood has become largely an area for residence rather than one in which economic production plays a prominent part. Thus it might be contended that the open-country neighborhood will survive to the extent that it can provide effectively those educational, recreational, and other services which make a given locality a good place in which to live.

The prediction might be ventured that if there is to be an open-country neighborhood of the future which has some permanency, it will have an organized structure with considerable informal association accompanying it. The organization will be multi-interest, will adjust to meet change, and will help relate the residents to one another as well as to the larger soicety. A recent attempt has been made in the South and specifically in the county studied to organize the open country neighborhood. This activity is called the "community club" program which is treated in the following section.

DEVELOPMENT ORGANIZATION IN THE OPEN COUNTRY

Development organization in the open country refers to those groups established on a neighborhood basis which have as their objective the improvement of living in the neighborhood. In the county studied these organizations were of two types. One was limited in its interest and generally in its sex and age groupings. It included 4-H Clubs, home demonstration clubs, Future Farmers and Future Homemakers of America, and forestry clubs. The second type of organization was the neighborhood club, called the community club. The community club was a multi-purpose organization which designated all families residing within the neighborhood as potential members. The discussion which follows deals with the neighborhood club.

The Club Movement in Alcorn County

The neighborhood club program in Alcorn County is a part of the movement which has developed through the state and the Southeast since World War II.[36] The first club of this type was organized in the county in 1952 by the professional agricultural leaders. This club was in one of the better farming neighborhoods which had a reputation of cooperation with county organizations (7). During the four-year period, 1952-1956, a total of 11 clubs were organized. In 1955, the county coordinating and sponsoring agency was established and named the Alcorn County Development Council. This council was made up of representatives from the neighborhood associations, the sponsoring civic clubs, and the professional agricultural leaders or workers.

In 1960, two additional clubs were organized. Thus, by the end of this year there was a total of 13 organizations. In 1961, however, one club was disbanded, and in 1962, two organizations were discontinued, leaving a total of 10.[37] In all three neighborhoods key leaders in the clubs had either died or moved away. In one neighborhood the population decline was very rapid, and in another, residents of the locality became seriously divided over school issues.

By 1963, open-country club organization had reached a plateau, and its future appeared to depend on several rapid and critical changes occurring in the county. These included occupational shifts, which have been discussed above, and county-wide organizational strategy and effectiveness, which is considered below.

The relation of neighborhood clubs to schools is seen in the fact that of the 10 active clubs in 1963, four were meeting in a building which was formerly used for the school and had been sold to the neighborhood association as a club house. A fifth club was planning to purchase a school building as a meeting place. A sixth club met in a church, and the remaining four met in school buildings now in use.

In the late fifties approximately one-fifth of the families in the neighborhoods in which clubs were organized participated in these associations. The membership averaged around 25 or 30 families.

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[36] For a treatment of these programs see Harold F. Kaufman, **Community Development Programs in the Southeast,** Miss. State College Social Science Research Center, Community Series **No.** 9, June, 1956.

[37] In 1952, 164 clubs were reported active in the state. By the mid-fifties this number had increased to over 400 and by 1963 to over 500.

Club Activities

Programs of the clubs were varied and covered a number of major interests ranging from development of agriculture and improving homemaking to recreational activities (7) A club typically had a monthly meeting balanced with educational and recreational activity. Educational topics were of a wide range including many community problems as well as specific presentations on agriculture and homemaking. As the number of families engaged in agriculture rapidly declined, the number of programs devoted to agricultural topics likewise decreased. In addition to monthly meetings, clubs had special projects such as work days for repairing and landscaping buildings, fund raising campaigns, and community tours.

Clubs usually made an annual plan of work and established committees to carry out various aspects of their program. At the end of each year the county council held a meeting at which time awards for outstanding achievements were made.

Neighborhood Factors in Club Success

An effort was made to discover those factors within a neighborhood which might be favorable toward the organization of a development club, and if one were organized, to influence its successful operation (10). Data from the 15-neighborhood survey were used for this analysis. The neighborhoods were classified as to those which had clubs, those which had more limited improvement organizations but not community clubs, and those without any organization except possibly a church. Several factors stoood out which differentiated the club neighborhood from the others, especially from those without improvement organizations. One characteristic of club neighborhoods was their long history of extensive neighborhood activity. They had relatively more improvement organizations, schools, churches, and economic services than had other neighborhoods. There was decidedly more awareness as to the identity of community leaders in the club neighborhoods than in the others.

There was not only more activity within neighborhood boundaries, but there was also more contact with the outside. Residents of club neighborhoods had a higher rate of membership in organizations other than the church, particularly those promoting educational and development programs. Although club neighborhoods were on the average larger than neighborhoods without organization, this fact in itself did not appear to be directly related to organizational effectiveness. Rather than the total number of families, the number of families of relatively high socio-economic level and interest in development programs appeared to be the significant factors.

Contribution to Development

Several contributions of the community clubs to development may be noted. One was the role of clubs in improving agriculture. Although club members on the average followed more recommended practices than did nonmembers, and for the period studied, 1954-1957, had a higher rate of adoption, it is not clear to what extent, if any, the club contributed to this differential. Certainly those people with education and other characteristics conducive to the acceptance of recommended practices were also more likely to belong to clubs. Possibly the indirect effect of the community club was the important contribution. That is, it pointed up problems for solution and generated motivation rather than providing specific and detailed technical knowledge.

Also, it should be noted that the nonfarm membership in community clubs increased rapidly for the period following the mid-fifties when most clubs were organized. A study of six clubs revealed that in 1955 less than one-third of the families in these organizations had no income from agriculture (3). By 1958 this proportion had increased upward to one-half of the total, and by 1963 it is quite likely that the proportion was reversed from what it was eight years earlier.

A second contribution of the community club to economic development was in providing a channel of communication in respect to nonfarm employment, especially in manufacturing. The club provided a medium by which residents of the nighborhood were informed as to the need for support for new industry and also of the opportunities available for employment.

A third contribution of the clubs was in the standards they set for good living. These related to adequate recreational facilities for youth, support of the schools and churches, and the utilization and need of health and welfare services. As the neighborhoods have fewer and fewer farmers, programs aimed primarily at building better places in which to live through improved institutions and group activities are likely to be the dominant object of club activity.

It is quite possible that the greatest contribution of neighborhood clubs is not to be measured in physical terms but rather with respect to leadership development and the strengthening of groups which promote desirable change. It might be said that an effective neighborhood club sets the tone or sensitizes the residents of an area as to the need for change[38].

Although raising income and providing community services were frequently cited as contributions of neighborhood clubs, "the improvement of community spirit and pride" are probably the most frequently mentioned and strongly supported justification for club organization. Related to the strengthening of neighborhood relations was also the very obvious contribution the clubs made toward improving relationships between town and country. The unique tie-up discussed below between civic clubs in Corinth and the open-country organizations helped greatly to minimize the differences between the town and the rural neighborhoods.

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[38] Cf. "Sensitivity Training," L. P. Bradford and Dorothy Mial, **Community Development Review,** Vol. 8, No. 1, Mar. 1963.

ORGANIZATION OF THE TRADE AREA

This report to this point has been concerned with documenting and interpreting changes in a trade area in the Southeast which is to some degree representative of the region and possibly other parts of the nation. Changes, almost revolutionary in speed, have been noted. These have occurred with respect to occupation, level of living and organization of the open country.

In this section a central objective of the study is pointed up, namely, the contribution of county and trade center development organizations in promoting and guiding desired change. Certainly the major forces of change are outside the community, but this does not mean that within certain limits there is not the possibility of considerable local initiative. It appears that many crucial decisions related to the establishment of new enterprises providing non-farm jobs are made by local leaders.

In trade areas as small as the Alcorn-Corinth one and in the early stages of industrialization, decisions by local leaders may be relatively more important than in larger places with a more advanced industrial trade complex. Growth is not automatic as is shown by the radical decline in population of many agricultural counties in the two decades following World War II.

Dynamics of Development

Development organization, more adequately termed the dynamics of development, has at least three aspects which should be noted here — structure of organization, nature of leadership, and process. Such analysis is to be seen against the background factors of location and resources[39]. The organizational structure is both formal (organized) and informal and represents several interests such as agriculture, industry and the services. This structure also has essential decision-making elements such as planning councils and coordinating groups.

A second essential aspect of the dynamics of development is to be seen in the nature of the leadership. Both paid and voluntary leaders who collectively possess technical skills and the knowledge and art of human relations are needed. This latter talent and ability is especially important in the executives of the developmental organization. Alcorn County was especially fortunate to have paid and voluntary leaders of high ability in stratgeic positions during the 1952-62 decade described below.

A third important aspect of the dynamics of development is the process as seen in terms of decision-making and stages of action. A key factor is the timing of decisions in terms of local needs, resources, and outside support. A selection of the appropriate time to act is to some degree in the hands of local leadership. Fortunate is the community which has paid workers and volunteers with this sense. Some events within and outside the community are, of course, fortuitous and beyond the control of the local leaders.

Areas of Interest and Organization

The importance of a complex of development organizations is seen when the town and country trade area of today is compared with that of a generation ago or with situations in underdeveloped countries at the present time. This complex of development organizations, including its paid leadership and clientele, is an invaluable factor in mobilization for change.

The most highly developed complex of organizations in a traditionally farming county such as Alcorn is the agricultural one. At the time of this study there were approximately a score of different types of agricultural agencies and membership organizations and more than that number of professional workers. County agricultural organization had its beginning with the creation of the local office of the Agricultural Extension Service in the second decade of the present century. The number of agencies grew rapidly in the depression of the thirties. They serve all aspects of agricultural and forest production and marketing[40].

As noted in the preceding section, many agricultural, homemaking, and forest organizations had neighborhood clubs or chapters. There were approximately 50 different neighborhood organizations of this type in the mid-fifties. The Alcorn County Farm Bureau was a county membership organization. There were several councils of agencies and organizations. These included the Home Demonstration Council, the 4-H Advisory and Junior Councils, the Alcorn County Development Council (council of community clubs), and the Agricultural Coordinating Council.

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[39] This study has taken these factors as given and has left detailed analysis to the economist and the physical planner.

[40] In addition to the Agricultural Extension Service those agencies serving the county include the Agricultural Stabilization and Conservation Service, the Farmers Home Administration, the Federal Crop Insurance Agency, the Mississippi Forestry Commission, the Soil Conservation Service, the Vocational Agricultural Departments, the National Farm Loan Association, the Tupelo Production Credit Association, the Alcorn County Artificial Breeders' Association, and the Alcorn County Cooperative.

The pattern of the Agricultural Coordinating Council was developed by the USDA in the late thirties. Mississippi has been known for its strong state and county councils. The Alcorn County group was reorganized in 1960 as the Agricultural Workers' Council, and at the time of this writing provided an important co-ordinating and communication function in rural community development.

The business-industrial complex of organization centered in the Corinth Chamber of Commerce. Other groups and agencies which played an important role in this area of interest were the city and county governments and the Mississippi Employment Service. The Chamber of Commerce was organized on a full-time basis in 1955 and during the following eight years had an impressive record of accomplishments. It had several programs and committees concerned with trade area development. Among the interests organized in 1963 were agriculture and forestry, airport, highways, industrial development, travel development, and merchants' promotion.

A third grouping relevant to development consisted of the service groups and institutions. In this classification were found such agencies as the Public Health Department, the Public Welfare Department, and the Northeast Mississippi Regional Library. Highly institutionalized groups included schools and churches. All of these agencies and associations focused on services to families and individuals and had special relevance for use of leisure time.

Perhaps the greatest opportunity for creativeness and development of community distinctiveness lies with what has been termed the service groups and institutions. A national market leaves its imprint of uniformity on all types of economic activities as do government-oriented programs. Thus, in the so-called community of residence probably lies the greatest opportunity for distinctively local initiative.

Overall Coordination and Planning

Of central concern in development is an organizational structure which carries out coordination of activities and long-range planning. For the period of study two organizational centers of planning emerged. For agriculture, there was the Alcorn County Development Council in which the Agricultural Extension Service played a prominent role. For industry and trade there was the Chamber of Commerce.

Certainly the several aspects of economic life need to be seen as integral parts of the total picture in long range planning. The most effective type of coordinating agency is a moot question. Whether a trade area such as the one studied can operate more effectively with one overall organization or two or more centers of leadership is a question on which all evidence is not in. There had been two proposals, both initiated by the Agricultural Extension Service through its state and national programs, for an overall coordinating and planning agency. One was the county program projection activity in the late fifties, and the other, the Rural Areas Development Program of the early sixties.

There had been extensive discussion

by county leadership of both of these proposals. The consensus was that the present dual but closely coordinated organization was producing satisfactory results, and that the leadership and the design for a uniting superstructure to replace the present organization would be difficult to realize.

There were many ties between the rural and agricultural programs on the one hand and the industrial and trade activities on the other. Perhaps the most effective method of coordination and unit planning came through the informal contacts of both paid and volunteer leaders. These contacts were seen in coffee cliques, civic clubs, churches, and recreational groups. At the formal level, business and industrial leaders played a prominent role in the Alcorn County Development Council. On the other hand, the Chamber of Commerce had, as mentioned above, a Committee on Agriculture and Forestry. The executive of this agency was secretary of the Fair Board. Less formal from an organizational standpoint but a significant index of the close cooperation between business and agriculture was the fact that the monthly meeting of the Agricultural Coordinating Council was held in the Chamber of Commerce office.

Significant in the process of communication and planning was the civic club. Eight service clubs, two of them women's clubs, were located in Corinth, and one was found in the village of Rienzi. Programs of these clubs and contacts they provided appeared to make decided contributions toward providing information, and toward motivating members to take part in community projects.

A Decade of Development

The period, 1952-1962, might well be termed a decade of development in Alcorn County[41]. The progress made here should of course be seen within the context of rapid regional and national development. Development might be seen in terms of stages in the process, development structures, and specific projects or results. The latter are the major concern of this section.

Effective programs frequently grow out of a reaction to serious problems. In 1952 an apparel industry which employed over one-third of all the workers in manufacturing was closed. At this time also were occurring rapid adjustments in agriculture. Both of these conditions served as stimulants to the creation of development organization. By 1955, as has been noted above, the Alcorn County Development Council had been organized and a full-time program in the Chamber of Commerce had been initiated.

Specific projects included both those providing jobs and those improving community services. During the decade under consideration 15 new industries were established in the county providing several thousand new jobs. In addition, a paper plant was built across the state line, which is manned by a relatively large number of workers from the Corinth trade area. Even a railroad was built to link the plant with the transportation outlets in Corinth.

During this decade radical change was to be observed in the country-side. Hard-surfaced and graveled roads were extended to all parts of the county. Telephone service was extended to hundreds of residents in the southern portion of the area. Many new homes were built, and farms were mechanized. A county airport was constructed, and soon thereafter scheduled air service was established.

The City of Corinth and suburbs saw the creation of an industrial park promoted by an Industrial Development Association. By 1963 this park had seven new industries. An urban renewal program had been inaugurated, and a city park and recreational program had been established. By the end of the decade commitments had been made to build a 117-bed county hospital at a cost of approximately $2.8 million.

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[41] The writers are indebted to the Corinth Chamber of Commerce and the Alcorn County office of the Agricultural Extension Service for much of the data used here and in preceding sections.

By this time plans were also under way for the development of the Tuscumbia River Watershed. When completed, this was expected to make a most important contribution to both agriculture and recreation in the area. The Watershed covers the better farming area in the center of the county. Equally significant for longtime development was the inauguration of a study aimed at establishing policy guidelines for future economic development. This study focused on a type of enterprise most suitable for the area, labor needs and resources, rate of growth, and services needed.

Some Questions: Answered and Unanswered

Development organization focuses on that aspect of the process which lies beyond resource analysis, and market and monetary trends. This concern for a detailed picture of organizational dynamics appears, however, to be necessary not only for the development of the "little economies" but also for good living — providing adequate services and institutions. Questions have been raised here concerning the structure of area planning and coordinating agencies and of the relation of these local associations to federal and state agencies. Also noted has been the necessity for specifying through further research, areas of action in which local initiative is especially relevant and useful.

Of special concern in this analysis was the role of open-country organizations. Does the community club movement, for example, foretell a new day for the countryside, or is it a last unsuccessful effort to preserve some semblance of open-country neighborhood organization?

There is some prospect of a new day for the countryside if it is realized that the providing of jobs is only one major objective of development. Another goal of equal importance is to maintain and improve the quality of living — to develop the community of residence.

APPENDIX

LIST OF SELECTED PUBLICATIONS IN THE ALCORN COUNTY STUDIES

Monographs

(1) Alexander, Frank D., **Rural Communities, Organized Groups, and Public Agencies in Alcorn County, Mississippi, In Relation to Community Development, Particularly Educational Programs Through Rural Community Clubs.** Miss. State College Division of Sociology and Rural Life, Preliminary Report in Community Organization No. 2, Nov., 1955. (98 pp.)

(2) Bailey, Wilfrid C., and Harold F. Kaufman, **Factors Related to Differential Participation Among Neighborhoods.** Miss. State College Division of Sociology and Rural Life, Preliminary Report in Community Organization No. 3, Oct., 1956. (7 pp.)

(3) Bailey, Wilfrid C., **Mississippi Community Fertilizer Education Experiment, Final Report,** Miss. State Univ., Preliminary Report in Sociology and Rural Life No. 7, Mar., 1959. (84 pp.)

(4) Bailey, Wilfrid C., and Ellen S. Bryant, **Adoption of Homemaking Practices in Alcorn County, Mississippi.** Miss. Agr. Exp. Sta. Progress Report in Sociology and Rural Life No. 25, July, 1962. (52 pp.)

(5) Bailey, Wilfrid C., and Ellen S. Bryant, **The Use of Fertilizer by Farmers in Alcorn County, Mississippi.** Miss. Agr. Exp. Sta. Progress Report in Sociology and Rural Life No. 26, Aug., 1962. (54 pp.)

(6) Baird, Andrew W. and Wilfrid C. Bailey, **Farmers Moving Out of Agriculture,** Miss. Agr. Exp. Sta. Bul. 568, Oct., 1958. (7 pp.)

(7) Baird, Andrew W., and Wilfrid C. Bailey, **Community Development Clubs in Alcorn County, Mississippi.** Miss. Agr. Exp. Sta. Bul. 597, May, 1960. (26 pp.)

(8) Baird, Andrew W., Lucy W. Cole, and Harold F. Kaufman, **Development of Human Resources in Alcorn County,** Mississippi. Miss Agr. Exp. Sta. Progress Report in Sociology and Rural Life No. 19, Sept., 1961. (75 pp.)

(9) Bryant, Ellen S., and Wilfred C. Bailey, **The Rural Working Homemaker, Alcorn County, Mississippi.** Miss. Agr. Exp. Sta. Progress Report in Sociology and Rural Life No. 20, Sept., 1961. (21 pp.)

(10) Cole, Lucy W., and Harold F. Kaufman, **Factors in Rural Neighborhood Development in Alcorn County, Mississippi.** Miss. Agr. Exp. Sta. Bul. 625, July, 1961. (20 pp.)

(11) Gillis, Willie Mae, **The Adoption of Recommended Farm Practices in Alcorn County and Its Relationship to Other Variables.** Miss. State College Preliminary Report in Sociology and Rural Life No. 5, August, 1958. (12 pp.)

(12) Kaufman, Harold F. (ed.), **Community Structure and Farmer Education** (Papers by H. A. Pedersen, D. W. Rivers, **et al.**), Miss. State College Sociology and Rural Life Series No. 8, Jan., 1957. (18 pp.)

(13) Silverman, Leslie J. and Wilfrid C. Bailey, **Trends in the Adoption of Recommended Farm Practices, Alcorn County, Mississippi, 1954-1957.** Miss. State Univ. Agr. Exp. Sta. Bul. 617, April, 1961. (8 pp.)

Other Papers

(14) Aurbach, Herbert A., and Harold F. Kaufman, "Knowledge and Use of Recommended Farm Practices," Miss. Agr. Exp. Sta. Information Sheet No. 540, June 1956. Reprinted from **Mississippi Farm Research,** Vol. 19, No. 6 (June, 1956), p. 6.

(15) Bailey, Wilfrid C., and Andrew W. Baird, "Community Development Clubs Aid Farmer Education." Miss. Agr. Exp. Sta. Information Sheet No. 548, Dec., 1956. Reprinted from **Mississippi Farm Research,** Vol. 19, No. 12 (Dec., 1956). p. 6.

(16) Bailey, Wilfrid C., and Ellen Bryant, "Homemaking Practices in Alcorn County," **Mississippi Farm Research,** Vol. 20, No. 11 (Nov., 1957), pp. 7-8.

(17) Bailey, Wilfrid C., "Changes in School Districts and Neighborhood Boundaries for a Thirty-Year Period in a Selected Mississippi County," pp. 24-25 in **The Church and the School in Community Development,** (Mary B. Whitmarsh and Harold F. Kaufman, eds.). Miss. State College Sociology and Rural Life Conference Series No. 5, Feb., 1958.

(18) Bailey, Wilfrid C., and Andrew W. Baird, "Community Clubs . . . Medium for Education," **Extension Service Review,** Vol. 31, No. 7 (July, 1960), pp. 133 and 140.

(19) Cole, Lucy W., "Trends in Population and Number of Churches in Rural Alcorn County," **The Church and the School in Community Development,** Mary B. Whitmarsh and Harold F. Kaufman, (eds.). Miss. State Sociology and Rural Life Conference Series No. 5, Feb., 1958.

(20) Cole, Lucy W., "What is Happening to Rural Neighborhoods," Miss. Agr. Exp. Sta. Information Sheet No. 598, July, 1958. Reprinted from **Mississippi Farm Resarch,** Vol. 21, No. 7 (July, 1958), pp. 4-5.

(21) Douglas, George V. (ed.), **Community Clubs and Fertilizer Education,** Knoxville: Miss. State College in Cooperation with the Tennessee Valley Authority, p. 57-1 AE, Oct., 1956. ((11 pp.)

(22) Dunkelberger, John E., "Characteristics and Types of Families in Low-Income Rural Areas," pp. 189-203 in **Seminar in Comparative Studies in Rural Social Change** (A. W. Baird, ed.) Miss. State College Sociology and Rural Life Conference Series No. 8, Jan., 1960.

(23) Kaufman, Harold F., and Herbert A. Aurbach, "A Case Study in Farmer Education," pp. 20-27 in **Experimental Approach to Farmer Education: Papers Presented at Association of Southern Agricultural Workers, Louisville, Kentucky, Feb. 7-9, 1955.** Knoxville: Tennessee Valley Authority, Report No. T 55-2, 1955.

(24) Kaufman, Harold F., and Wilfrid C. Bailey, "Planning Rural Development," **The Church in the Changing Community, Proceedings of the Eighth Annual Institute for Town and Country Church Leaders.** Miss. State College Sociology and Rural Life Conference Series No. 2, Feb., 1956, pp. 20-26.

(25) Kaufman, Harold F., Frank D. Alexander, and Herbert A. Aurbach, "A Case Study in Research Interpretation," Reprinted from **Rural Sociology,** Vol. 22, No. 2 (June, 1957). pp. 156-162.

(26) Kaufman, Harold F., and Ellen Bryant, "Characteristics of Farmers Following Recommended Practices," Miss. Agr. Exp. Sta. Information Sheet No. 608, Nov., 1958. Reprinted from **Mississippi Farm Research,** Vol. 21, No. 11 (Nov., 1958). pp. 3-5.

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Sesame Production In The Mississippi Delta

By THOMAS W. CULP

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Summary

Results of variety trials indicate that excellent yields of sesame can be produced in the Mississippi Deltal during most years. Outstanding yields of approximately 2500 pounds of seed per acre were produced in 20-inch rows at Stoneville in 1962.

The principal problem with sesame is that the present varieties cannot be satisfactorily harvested by mechanical methods in this area of high rainfall and humidity. Dehiscent sesame, which must be cut and shocked before threshing, will not dry properly under the humid conditions that usually exist. Indehiscent sesame has not been accepted, since producers are not willing to devote the necessary time and care required to combine the crop.

At present, sesame should be recommended only to interested farmers who understand the production problems and will take the care and have the patience to do a good job of harvesting the crop. It is believed that easily harvested varieties will be developed in the future. If so, sesame could become a promising new oilseed crop for the Mississippi Delta and surrounding area.

SESAME PRODUCTION IN THE MISSISSIPPI DELTA

By THOMAS W. CULP[1]

Although sesame has never been grown as a commercial crop in Mississippi, variety trials have been conducted at various times since 1952. In general, yields of varieties and promising selections have been most satisfactory. In some cases, outstanding yields have been produced.

Regional sesame yield tests were conducted on the Experiment Station at State College, Mississippi, by J. F. O'Kelly and G. D. Green from 1956 through 1960. The average yield of all varieties and selections was 830 pounds of seed per acre. The highest yield in these tests, 1526 pounds of seed per acre, was obtained with the variety Margo in 1956.

Similar yield tests were conducted at The South Mississippi Branch Station, Poplarville, Mississippi, by T. E. Ashley and W. W. Kilby from 1957 through 1959. Diseases of sesame were a greater problem at this location and yields were less than those obtained at State College

In 1959, it was reported[2] that the average yield of all varieties grown in comparable variety trials at the Delta Branch Experiment Station, Stoneville, Mississippi, from 1952 through 1958 was 1049 pounds of seed per acre. The highest yield in these tests, 2071 pounds of seed per acre, was obtained with the variety, Llano in 1957. High yields of sesame and the stimulated interest of possible producers in this crop resulted in an expanded program of variety testing in the Mississippi Delta.

Regional Sesame Tests

Comparable regional sesame yield tests were conducted at Cleveland, Mississippi, in 1958 and 1959 and at Greenwood and Stoneville from 1958 through 1960. Oro and its sister selection, S.I. 58, produced the highest average yields in all tests, 1657 and 1684 pounds of seed per acre, respectively (Table 1). This variety or selection also produced the highest average yield at each location, and Oro produced the outstanding yield, 2043 pounds per acre, in the 1958 test at Cleveland. Calinda and Llano produced very good average yields, 1578 and 1458 pounds, respectively.

Blanco, Margo, S.I. 74, and Dulce produced average yields of only 1049 to 1182 pounds. These low yields were attributed to loss of growing points (cause unknown) and premature senescence of many plants at Greenwood and Stoneville in 1958 and 1959. The average yield of these varieties and selections at Greenwood and Stoneville during this period was only 816 pounds of seed per acre.

The selections S.I. 109 and 125 had the highest average yields, 1445 and 1336 pounds of seed per acre, among the indehiscent entries in these tests. Rio, one of the first released indehiscent varieties, made the third highest average yield, 1252 pounds. These data indicate a possible improvement in yield of S.I. 109 and 125 over Rio. The other indehiscent entries in these tests produced average yields of 973 to 1202 pounds of seed per acre. The low yields of these varieties and selections can be attributed partly to loss of growing points of plants at Greenwood and Stoneville in 1958 and 1959.

Average yields of all dehiscent varieties and selections at Cleveland, Greenwood, and Stoneville, Mississippi, were 1515, 1252, and 1283 pounds of seed per acre, respectively. At all locations it was 1350 pounds per acre.

The average yields of all indehiscent varieties and selections grown at these

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[1] Research Agronomist, Crops Research Division, Agriculture Research Service, U. S. Department of Agriculture in cooperation with the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

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[2] Thomas W. Culp and William J. Stone. Factors affecting sesame production in the Mississippi Delta. Mississippi Farm Research. Vol. 22, No. 10. October 1959.

Table 1.—Yield and other characteristics of comparable varieties and selections of sesame grown in regional tests at Cleveland, Mississippi, in 1958 and 1959, and at Greenwood, and Stoneville, Mississippi, from 1958 through 1960.

Variety or selection	S.I. No.	Yield in pounds of seed per acre				Threshing percentage	Percentage shattering
		Cleveland	Greenwood	Stoneville	Avg.		
	Dehiscent (shattering) varieties and selections						
T53181-3-20-4-5-1-1-2[1]	58	1773	1510	1769	1684	...	----
Oro	61	1882	1382	1707	1657	...	----
Calinda	47	1587	1429	1718	1578	...	----
Llano[2]	8	1648	1212	1513	1458	...	----
Dulce	46	1601	1042	903	1182	...	----
T54137-2-2-B-1[1]	74	1050	1373	965	1129	...	----
Margo	39	1298	1051	856	1068	...	----
Blanco	3	1288	1023	837	1049	...	----
	Indehiscent (non-shattering) varieties and selections						
T54118-5-1-2-1-2	109	1541	1304	1489	1445	63.1	8.4
T55388-B-7-2-5	125	1238	1332	1437	1336	74.2	10.4
Rio[2]	78	1160	1372	1224	1252	64.6	9.5
T53181-3-20-4-1-1-2	89	1094	1192	1319	1202	76.2	16.2
T55142-B-11-2-10[1]	128	1020	1214	1312	1182	83.7	31.0
T55433-B-1-1	139	1005	1394	968	1122	78.5	22.0
Delco[2]	77	1220	933	792	998	83.4	20.0
T55154-B-2-4[3]	117	1039	1149	730	973	83.4	31.7
Location average		1340	1248	1221	1270	----	----

[1] Not grown in 1958.

[2] Not grown in 1960.

[3] Grown only in 1959.

locations were 1165, 1242, and 1159 pounds, respectively. At all locations it was 1189 pounds of seed per acre.

The indehiscent selection S.I. 128 produced the highest yield, 1864 pounds, in the 1960 test at Stoneville. This yield is approximately 200 pounds less than the highest yield of the top-yielding dehiscent variety. The average yield of all indehiscent varieties and selections is 161 pounds less than the average yield of all dehiscent varieties and selections in these tests. Although dehiscent sesame generally yields more seed than indehiscent sesame, both types have produced excellent yields in the Mississippi Delta during most years.

The principal problem with this crop is that present varieties cannot be satisfactorily harvested by mechanical methods in this area of high rainfall and humidity. For this reason, yield testing was reduced and confined to the Delta Branch Station in 1961 and 1962.

Tests at Delta Station

Sesame yield tests on the Delta Branch Station in 1961 and 1962 were designed to compare yields of varieties and promising selections and to obtain additional information on the effects of row spacings on maximum yields and weed control. Two regional yield tests were grown each year in 1961 and 1962. One test was planted in 40-inch rows and the other in 20-inch rows.

Yields were very low in 1961 (Table 2). The average yield of all varieties and selections was only 711 pounds of seed per acre when grown in 40-inch rows and 829 pounds of seed per acre when grown in 20-inch rows. These low yields were obtained because Alternaria and Corynespora leaf and stem spot defoliated the plants and caused them to mature early in the season. This was the first time that these diseases caused appreciable damage to sesame. Generally, these diseases occur late in the season and act as beneficial agents by defoliating and drying the plants for harvest.

In 1961, Calinda produced the highest yields, 1162 and 1354 pounds of seed per acre, when planted in 40- and 20-inch rows, respectively. This yield was not significantly greater than the highest yields of the indehiscent selection S.I. 151, which made 939 and 1267 pounds. Two sister selections, T55191-B-1-1-M1-2-B-B and T55-191-B-1-1M11BB, produced the highest yields, 2108 and 2026 pounds, respectively, when planted in 40-inch rows in 1962. There were no significant differences between the other dehiscent entries, which produced 1358 to 1676 pounds of seed per acre, except Calinda which produced the lowest yield of 1156 pounds.

In the test planted in 20-inch rows in 1962, S.I. 155 produced the highest yield of 2572 pounds of seed per acre. This yield was not significantly different from yields of 7 other dehiscent varieties and selections which produced from 2038 to 2522 pounds. Only Calinda and S.I. 156 had lower yields of 1967 and 1665 pounds, respectively, in this test.

S.I. 128 produced the highest yield, 1225 pounds, among the indehiscent entries grown in 40-inch rows in 1962. This yield was not significantly different from that of the other indehiscent varieties and selections, which ranged from 901 to 1154 pounds. The indehiscent selections S.I. 160 and 161 produced the highest yields among indehiscent entries of 2075 and 1970 pounds respectively, when grown in 20-inch rows in 1962. These yields were not significantly different from that of the highest yielding dehiscent variety grown in this test. Only selection S.I. 159 produced a lower yield than the other indehiscent selections, 1389 pounds of seed per acre.

Table 2.—Yield and other characteristics of comparable varieties and selections of the regional sesame yield tests grown in 20- and 40-inch rows at Stoneville, Mississippi, in 1961 and 1962.

Variety or selection	SI No.	Yield in pounds of seed per acre						Threshing percentage	Percentage shattering
		40-inch rows			20-inch rows				
		1961	1962	Avg.	1961	1962	Avg	1961	1961
Dehiscent (shattering) varieties and selections									
Calinda	47	1162*	1156	1159	1354*	1967	1660	—	—
Margo	39	679	1565	1122	706	2247*	1477	—	—
T53181-3-20-4-5-1-1-2	58	735	1464	1100	988	2023*	1506	—	—
Oro	61	788	1406	1097	974	2038*	1506	—	—
T56065-B-3-2-1	153	530	1451	990	924	2318*	1621	—	—
T57109-B-3-3	154	915	—	—	876	—	—	—	—
T54137-2-2-B-1	74	572	—	—	362	—	—	—	—
T57109-B-3-3-3	155	—	1676	—	—	2572*	—	—	—
T58061-B-1-1	157	—	1522	—	—	2388*	—	—	—
T58128-B-5-4	156	—	1358	—	—	1665	—	—	—
T55191-B-1-1-M1-2-B-B	—	—	2108*	—	—	2271*	—	—	—
T55191-B-1-1-M1-1-B-B		—	2026*	—	—	2522*	—	—	—
Indehiscent (non-shattering) varieties and selections									
T56117-B-31-3-33-1	151	939*	978	958	1267*	1838	1552	88.2	5.2
T55142-B-11-2-10	128	486	1225	856	771	1687	1229	86.2	7.5
T55433-B-1-1	139	348	962	655	685	1532	1108	83.4	7.5
T56117-B-31-3-7-1	149	759	—	—	707	—	—	88.6	3.8
T56031-B-2-7	144	755	—	—	806	—	—	89.8	5.0
T56117-B-31-1-7-3	150	698	—	—	647	—	—	89.6	10.0
T56026-B-3-9-4	152	581	—	—	534	—	—	92.4	5.5
T56564-B-B-1-2	162	—	1154[1]	—	—	1698	—	—	—
T58399-B-2-1	160	—	1124	—	—	2075*	—	—	—
T58382-B-5-1	159	—	1119	—	—	1389	—	—	—
T58542-B-2-B-1	161	—	1058	—	—	1970*	—	—	—
T56026-B-3-4-1-1	158	—	901	—	—	1764	—	—	—
Average yield		711	1347	992	829	1998	1457	—	—
L.S.D. (5% level)		225	334	—	280	603	—	—	—
Coefficient of variation, %		22.2	17.4	—	23.7	21.2	—	—	—

[1] Missing plot calculated by appropriate statistical method.

*Indicates not significantly different from highest yielding variety in test.

In 1961 and 1962, the highest yielding dehiscent varieties and selections continued to out-produce the highest yielding indehiscent varieties and selections in most cases. In all cases, the average yields of dehiscent entries were greater than that of indehiscent entries by 109 to 508 pounds of seed per acre. These data suggest that it should be possible to continue to improve the yields of indehiscent varieties and selections through plant breeding.

Narrow Rows Control Weeds

Production of sesame in narrow rows may be an excellent method of reducing late weeds and increasing yields. Although yields were poor because of dry weather and diseases in 1961, the varieties and selections grown in 20-inch rows produced an average of 119 pounds of seed per acre more than the same varieties and selections grown in 40-inch rows. In these tests 9 of the 14 entries produced greater yields, which ranged from 27 to 394 pounds when grown in 20-inch rows. Since this was an unusually dry fall and Alternaria and Corynespora leaf and stem spot diseases caused early maturity of all varieties, it was expected that plants growing in 40-inch rows would show a yield advantage over those in 20-inch rows. Surprisingly, this was not the case and apparently sesame will produce just as well in 20-inch rows even when conditions are not ideal for maximum growth.

Varieties and selections grown in 20-inch rows in 1962 produced an average of 651 pounds of seed per acre more than the same varieties and selections grown in 40-inch rows. In these tests all entries produced greater yields, which ranged from 163 to 951 pounds of seed per acre, when grown in 20-inch rows. Since outstanding yields of sesame were produced and late-season weeds were easier to control in 20-inch rows, this would be a recommended method of producing this crop, if suitable equipment for cultivation is available on the farm and if sesame could be mechanically harvested satisfactorily in this area.

Harvesting is Problem

High yields obtained in variety trials since 1952 indicate that excellent sesame can be produced in the Mississippi Delta and surrounding area during most years. Harvesting by mechanical methods has proved to be the limiting factor in the production of the crop. Dehiscent sesame, which must be cut and shocked for harvesting, will not dry properly under the humid conditions that usually exist. Indehiscent sesame has not been accepted, since producers are not willing to devote the necessary time and care required to thresh the crop. If an easy method of harvesting or an easily harvested variety can be developed, sesame could become a promising new crop in this area.

Dehiscent sesame possessing strong placenta attachments, which might retain the seed until it could be combined from standing plants in the field, offers promise in the development of easily harvested varieties. Most of the present lines which possess strong placenta attachments are too late for production in this area, and they also dehisce from the apex to the base of the capsules. These lines hold most of their seed for a short time after maturity and then gradually lose them from weathering while the plants continue to dry. Crosses have been made in an attempt to obtain dehiscent plants possessing strong placenta attachments of seed that are borne in capsules which dehisce primarily at the apex and are borne in an upright position on the plants. The F_2 populations of these crosses were planted in 1963; therefore, it is too early to predict the outcome of these studies.

Indehiscent sesame possessing very long papershell capsules, which do not lose seed by partial dehiscence, offers promise in the development of easily harvested varieties. To date, most of the work in the development of easily harvested varieties has been conducted with this type material.

Progress on Varieties

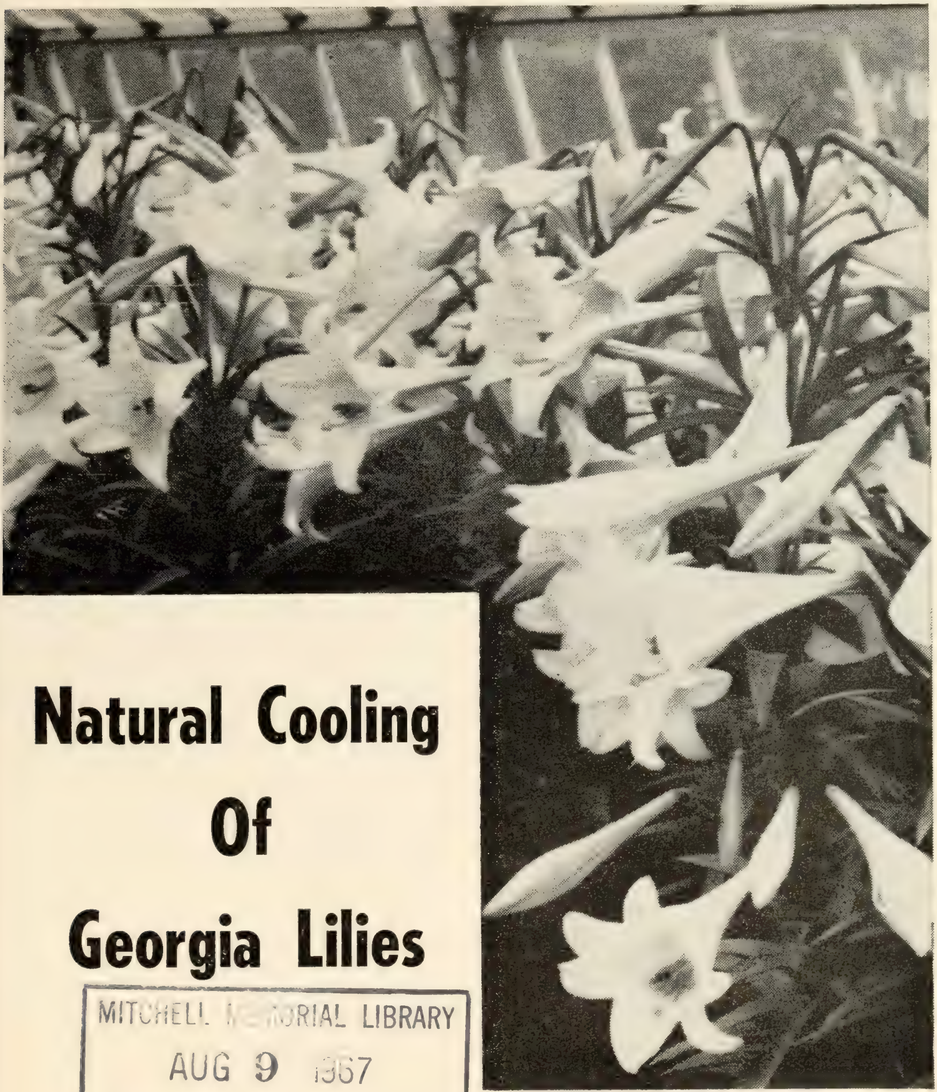
Much progress in the development of easily harvested varieties has been accomplished, as indicated by the threshing percentages of indehiscent varieties grown from 1958 through 1961. (Threshing percentages are calculated as the percentage seed obtained from the first of 5 runs through an experimental Vogel-type thresher). Rio, released in 1955 as one of the first indehiscent varieties, had a threshing percentage of 64.6% (Table 1). The first papershell variety, Delco, (released in 1957, had a threshing percentage of 83.4% and S.I. 128 had the highest, 83.7%; in these tests. In the test grown in 1961 (Table 2), S.I. 128 had a percentage of 86.2%; however, 5 of the 6 other indehiscent entries possessed higher threshing percentages than this selection. S.I. 152 produced the highest, 92.4%. The percentage shattering or loss of seed from partial dehiscence of Rio was 9.5%. Delco lost 20% of its seed while S.I. 128 lost 31% during the period from 1958 to 1960. In 1961,S.I. 128 lost 7.5% of its seed. Five of the 6 other indehiscent selections lost less or no more seed than this selection.

These data indicate that much progress in the development of easily harvested indehiscent varieties has been made since the first indehiscent variety was released in 1955. However, it is expected that future progress will be much slower.

The process of transferring strong placenta attachments to indehiscent lines which possess long papershell capsules and partially dehisce but are very easy to thresh, offers promise in the development of varieties easy to harvest. Crosses to effect this transfer have been made. The F_2 seed of these crosses was planted in 1963; therefore, it is too early to determine whether the strong placenta attachments will retain the seed in the indehiscent capsules which partially dehisce. If so, it should be possible to develop an easily harvested variety from this material.

It is hoped that one of these methods of breeding will produce a variety of sesame that is easy to harvest and adapted to production in this area. If this can be accomplished sesame could become a promising oilseed crop for the Mississippi Delta and surrounding area.

Sesame growing in the Mississippi Delta. Research indicates good yields can be produced most years but harvesting is a problem.



Natural Cooling Of Georgia Lilies

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HENRY H. LEVECK, Director
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SUMMARY

Studies over a two-year period at the Mississippi Agricultural Experiment Station show that Georgia lily bulbs can be successfully used in the production of potted Easter lilies if the proper cultural conditions are applied.

A strain of this variety developed in Mississippi appears to be exceptionally vigorous and 5-6 inch bulbs will produce an average of 6 to 12 blooms per plant. Natural cooling appears necessary but care must be exercised in application of subsequent forcing temperatures to insure maximum bloom number, height control and desired bloom date.

Bloom number appears to be directly related to plant "conditions", such as maximum root formation and top growth at time of and immediately following flower initiation (Figure 11). Preforcing "natural" temperatures, followed by a two week period at 50° F. night temperature, appear highly desirable to accomplish this. No doubt, other factors contribute, such as irrigation and especially fertilization. Forcing temperatures ranging from 60° to 70° F. night temperatures are satisfactory, the lower temperatures favoring tallness and increased bloom number with the opposite occurring at higher temperatures.

The lily apparently has a "threshold" temperature below which no growth occurs and above which growth proceeds in relation to the temperature, within limits. In other words, growth to maturity will proceed more rapidly at a higher temperature above the "threshold" than at a lower temperature, and a certain quantity of accumulated degrees is necessary to mature the plant. This is in agreement with results of other work on crops such as peas and corn and it is the "heat unit" principle. Night temperature apparently has more effect than day temperature.

Light has an extreme effect on height, perhaps both by quality and intensity. Glass house lilies were invariably taller than plastic house liles and is believed due to differences in light.

Natural Cooling of Georgia Lilies

By C. O. BOX[1]

The Easter lily is the leading pot plant produced and sold for Easter. Bulb producers generally harvest bulbs about August in the South and later in such areas as the west coast. The bulbs are then refrigerated at about 35° F. from harvest until shipment to greenhouse operators, a period of 10 to 14 weeks. They are then planted in pots and usually grown at 60° F. until flowering for Easter. About 120 days should be allowed from planting to maturity, depending on the variety. Lily bulbs require a certain amount of chilling, but these necessarily long storage periods apparently have a detrimental effect on the quality of the finished plant, presumably as a result of food depletion or some related factor.

Even though the lily still leads in pot plant sales for Easter, in recent years the demand for this crop has diminished. This is believed by some to be the result of inferior plants, perhaps caused by disease prevalence in the leading variety, Croft. Many growers began using the variety Ace, which appears to be more vigorous than Croft but not quite as desirable in appearance nor in time required to force.

A strain of the Georgia lily, commonly tall growing and used primarily in cut flower production, was selected by a commercial concern in Mississippi over a period of several years. This strain appears to be more vigorous with greater bloom production than the standard Georgia variety. Whether this is due to freedom from major harmful diseases and/or genetical factors is speculative; nevertheless, it appears considerably superior.

About 1957, the Horticulture Department of the Mississippi Agricultural Experiment Station began trial growing the large sized bulbs of this strain for cut flower purposes. The possibilities were evident, and therefore, thought was given toward production of the variety as a pot plant. Bulbs 7 to 9 inches in circumference (the size normally used for pots) were refrigerated after harvest in August in the commercially-accepted procedure. Plants forced in the recommended manner from these bulbs were acceptable as pot plants, but it was obvious that they were inferior to field plants allowed to flower normally. These field plants, from bulbs harvested in August and replanted in September, were very short and stocky with from 10 to 15 blooms per plant. They bloomed in May. Bulbs refrigerated from September to about January 1 and then potted and forced in a warm greenhouse for Easter (about April) were taller with longer internodes and with a much reduced bloom number.

It is well known that growers on the west coast under mild climatic conditions often pot bulbs without refrigeration, usually Croft or Ace, store them in frames outside where rosetting of foliage occurs as in the field, and then force them into bloom by Easter in greenhouses. In addition, this method was practiced with Georgia bulbs some years ago by Paterson's Rosemont Gardens in Montgomery, Alabama. The chief problem in both instances appeared to have been timing.

With this knowledge and that of observation of field grown plants in Mississippi, a preliminary experiment was begun in late summer of 1960 to determine the feasibility of production of the new strain of Georgia lily as pot plants by potting bulbs, on receipt from the producer without refrigeration. The experiment was designed to ascertain the proper cultural procedures to follow prior to movement to a greenhouse for forcing, as well as to determine the most desirable temperatures at which to force the plants for flowering at Easter.

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[1] The author is indebted to Mr. W. C. Gordon, Mr. K. P. Hance and Dr. W. W. Hare for aid in securing data and for useful suggestions and to Harson Growers of Wiggins, Mississippi, for supplying the necessary bulbs.

1960 Experiment

Two hundred and forty bulbs, 5 to 7 inches in circumference, were contributed by Harson Growers of Wiggins, Mississippi. These were received the latter part of August and planted in 5-inch clay pots September 1. The soil was one commonly used as potting soil and was fortified with phosphorus and lime with a pH of 6.8. These were divided into two groups and placed "pot to pot" outside on both a concrete slab and on soil with sod. Mulches of sawdust and soil were used around the pots and extended either to the pot rim or two inches over it. The primary purposes of the mulches were to prevent drying and freezing of the bulbs. In addition to the mulch, a wire mesh frame was constructed over the plants, 18 inches at the highest point and sloping toward the sides. Black plastic was used to cover the plants only at night when the temperature was expected to be below 25° F (Figure 1).

All plants were irrigated heavily at potting and as needed thereafter. A 2 to 1 mixture of ammonium nitrate and potassium chloride was applied as a liquid at the rate of 3 pounds per 100 gallons of water two weeks prior to forcing and at approximately two-week intervals up until flowering.

Forcing was begun 107 day, 93 days and 76 days before Easter. Night temperatures were maintained, when possible, either continuously at 50 and 60° F. or initially at 50° followed by 60°. Day temperatures were generally higher and fluctuated according to outside temperatures.

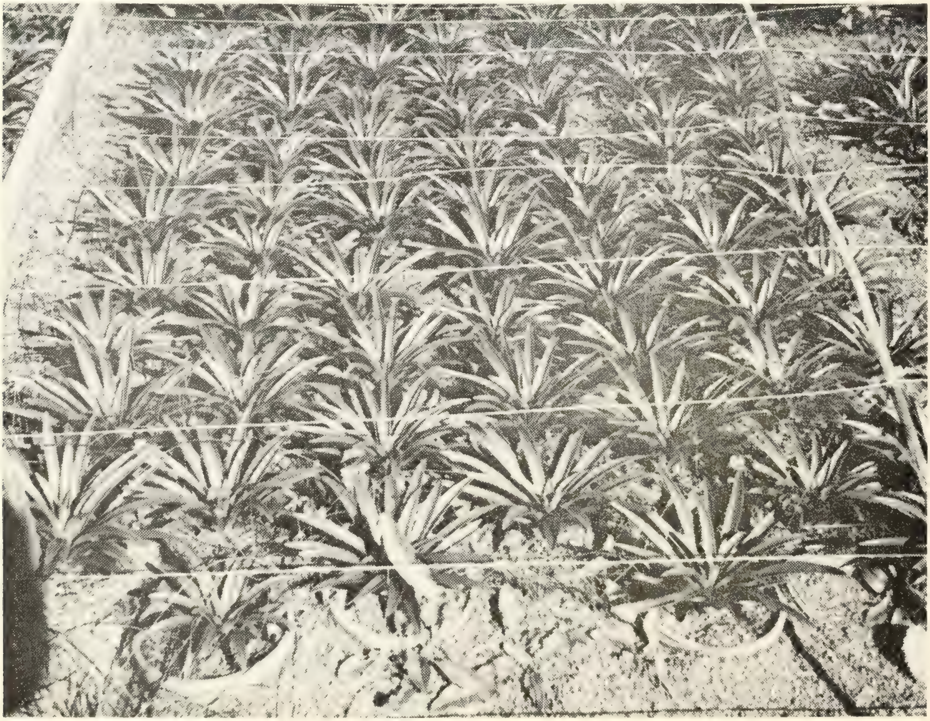

Figure 1. Lilies showing some growth during natural cooling outside in the month of October. Note the sawdust mulch and wire frame cover over which black plastic was pulled on cold nights.

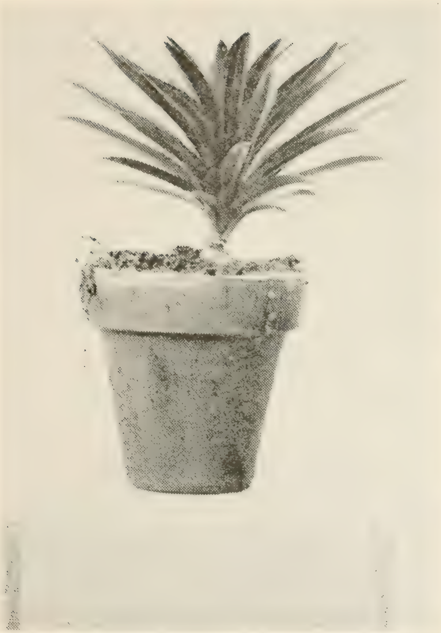

Figure 2. Natural cooled Georgia lily showing undesirable "shank" above pot caused by mulch over pot during cooling period.

Observations and records were maintained on emergence, freeze injury, height, bloom number and maturity date.

Results: Earliest stem emergence was October 7 from plants mulched to the rim with sawdust. Mulches of sawdust and soil 2 inches over pots delayed emergence and caused a "shank" bare of foilage near the pot, which was undesirable (Figure 2). It was concluded that sawdust was as good as or better than soil as a mulch and that plants could be grown equally well on soil as on a concrete slab. if adequate surface drainage existed.

After emergence, the foliage rosetted on a very short stem as shown in Figures 3 and 4. No appreciable injury was experienced from a temperature of 15° F. even though foliage froze. It should be noted that there were no plants without a mulch and injury in this case is speculative.

Due to the small number of plants per treatment and lack of replication in this preliminary experiment, accurate conclusions could not be drawn with regard to temperature effects on forcing, bloom number and height. However, it was obvious that low forcing temperature (50° F.) caused taller plants and a greater number of blooms. Also, a minimum period of two weeks at 50° followed by 60° for the remainder of the forcing period produced plants with a desirable height without materially reducing bloom number (see Table 1). It should be noted that these tremendous bloom numbers were produced from 5-7 inch bulbs. An average of 3-5 blooms from 7-9 inch Croft bulbs is considered good. The better treatments produced plants which required about 90-100 days from beginning of forcing to maturity.

The most pronounced and interesting effect of temperature was on timing. Table 1 shows that growth to maturity was in proportion to accumulated degrees of temperature once past a "threshold" temperature. For example, plants grown continuously at 50° flowered 12 days later than

Table 1.—Means for treatments of Georgia lilies natural cooled outside, 1960-61.

	Height inches	No. blooms	Date of bloom
50°F. 12/16	18.5	10.84	4/20
50°F. 12/16 then 60°F. 1/16	16.7	9.00	4/8
50°F. 12/16 then 60°F 2/23	18.3	11.28	4/13
50°F. 12/30	19.1	11.56	4/21
50°F. 12/30 then 60°F. 1/16	16.0	10.20	4/10
50°F. 12/30 then 60°F. 2/23	17.3	11.26	4/15
60°F. 1/16	16.8	8.72	4/13
50°F. 1/16 then 60°F. 1/30	16.8	8.52	4/17
Overall average	17.4	10.17	4/15

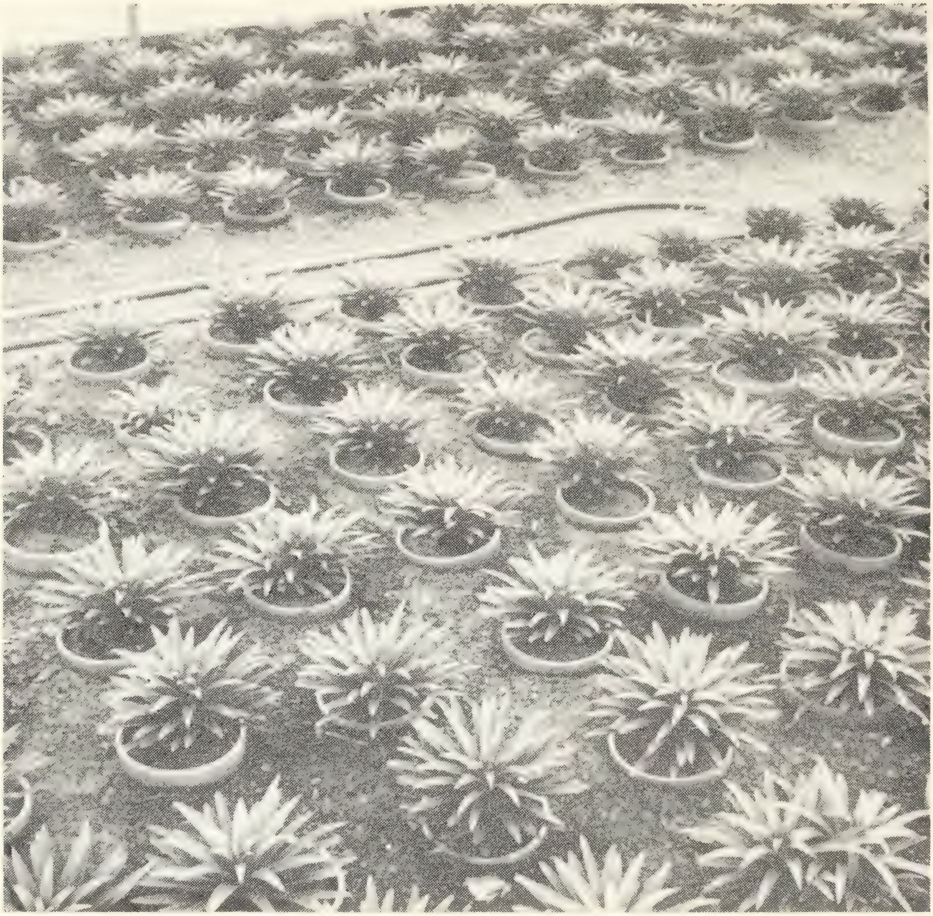

Figure 3. Typical rosetting of foliage of natural cooled Georgia lilies at about time of forcing.

plants grown continuously at 60° (after receiving 2 weeks at 50°) which amounted to a gain of approximately one day per week at 60° as compared to 50°. In addition, plants subjected to forcing in a greenhouse two weeks earlier than others bloomed only two days sooner. Once again, this was a gain of one day per week and tends to nullify the conception that timing is based on planting and/or forcing dates.

With this information, a more detailed experiment was begun in late summer of 1961. The objectives were to determine the amount of time necessary at 50° F. to insure maximum bloom number and to study the effects of subsequent forcing temperatures on height, number of blooms and maturity dates.

1961 Experiment

Bulbs 5-6 inches in circumference were received in late August and potted September 1 as described previously. They were placed outside on soil, mulched with sawdust and otherwise treated as described previously. First emergence was October 15 and last emergence noted was

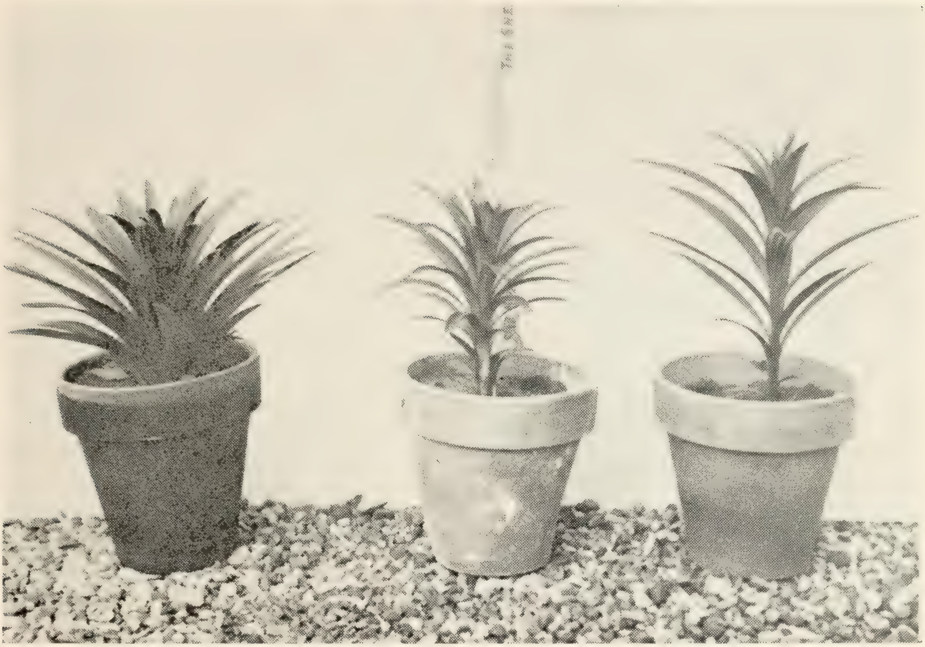

Figure 4. Left to right: natural cooled Georgia lily, pre-cooled Croft lily and pre-cooled Georgia lily. Bulb size of Croft 7-9 inches and 5-6 inches for the Georgias. Note heavy foliage of the natural cooled plant. Picture taken in January soon after forcing began.

October 29. Daily temperatures outside from September 1 to December 31 ranged from 20° to 94° F. with an average low of 49.8°, and average high of 70.9° and an overall average of 60.4°.

The plants were moved to a glass greenhouse on January 9 and placed on raised benches. There was a total of 780 plants in 26 treatments distributed at random in six replications. The control treatment was at a night temperature of 50° F. for two weeks followed by 60° until flowering. All other treatments had a beginning night temperature of 50° with increments of one

Table 2.—Comparisons of night forcing temperatures following 50° F. for 2 weeks.

	Means		
Treatments	Height inches	No. blooms	Days to maturity
60°F. to flowering (control)	19.75	7.56	91
60°F. for 2 weeks then 65°F. to flowering	17.70	6.86	83
60°F. for 2 weeks then 70°F. to flowering	16.23	6.80	78
65°F. to flowering	17.65	7.36	82
70°F. to flowering	14.88	6.36	75

[1]Forcing began January 9, 1962.

Table 3.—Comparisons of night forcing temperatures following 50°F. for 3 weeks.

Treatments	Height inches	No. blooms	Days to maturity
60°F. to flowering (control)	19.75	7.56	91
60°F. for 2 weeks then 65°F. to flowering	18.28	7.46	85
60°F. for 2 weeks then 70°F. to flowering	18.45	7.13	79
65°F. to flowering	18.05	7.23	83
70°F. to flowering	15.80	6.03	76

[1]Forcing began January 9, 1962.

week extending from 2 weeks up to 6 weeks. These were followed by higher temperatures as shown in Tables 2, 3, 4, 5, and 6. These night temperatures were kept as nearly constant as possible but fluctuation existed to some extent caused by outside temperatures.. Day temperatures were in general, 10° higher but varied according to weather conditions. Data were recorded on height of total plant, date of

Table 4.—Comparisons of night forcing temperatures following 50°F. for 4 weeks.

	Means		
Treatments	Height inches	No. blooms	Days to maturity
60°F. to flowering (control)	19.75	7.56	91
60°F. for 2 weeks then 65°F. to flowering	18.00	6.97	87
60°F. for 2 weeks then 70°F. to flowering	19.26	7.16	82
65°F. to flowering	17.78	7.03	86
70°F. to flowering	17.94	6.75	80

[1] Forcing began January 9, 1962.

Table 5.—Comparisons of night forcing temperatures following 50°F. for 5 weeks.

	Means		
Treatments	Height inches	No. blooms	Days to maturity
60°F to flowering (control)	19.75	7.56	91
60°F. for 2 weeks then 65°F. to flowering	18.68	7.10	90
60°F. for 2 weeks then 70°F. to flowering	19.20	7.00	85
65°F. to flowering	18.33	7.60	88
70°F. to flowering	18.65	6.73	83

[1] Forcing began January 9, 1962.

Table 6.—Comparisons of night forcing temperatures following 50°F. for 6 weeks.

	Means		
Treatments	Height inches	No. blooms	Days to maturity
60°F. to flowering (control)	19.75	7.56	91
60°F. for 2 weeks then 65°F. to flowering	17.83	7.90	93
60°F. for 2 weeks then 70°F. to flowering	18.20	6.73	88
65°F. to flowering	17.85	7.13	90
70°F. to flowering	18.68	6.94	85

[1] Forcing began January 9, 1962.

Table 7.—Comparisons of various intervals of night temperature at 50°F.

Treatments	Height inches	No. blooms	Days to maturity
60°F. to flowering (control)	19.75	7.56	91
50°F. (2 weeks) 70°F. to flowering	14.88	6.36	75
50°F. (3 weeks) 70°F. to flowering	15.80	6.03	76
50°F. (4 weeks) 70°F. to flowering	17.94	6.75	80
50°F. (5 weeks) 70°F. to flowering	18.65	6.73	83
50°F. (6 weeks) 70°F. to flowering	18.68	6.94	85

[1] Forcing began January 9, 1962.

Table 8.—Effects of day temperature.

	Means		
Treatments	Height inches	No. blooms	Days to maturity
60°F. to flowering (control)[2]	19.75	7.56	91
50°F. for 2 weeks night & day, then 50°F. night—80+°F. day	19.46	7.36	98
50°F. for 3 weeks night & day, then 50°F. night—80+°F. day	19.88	7.16	98
50°F. for 4 weeks night & day, then 50°F. night—80+°F. day	20.11	6.90	100
50°F. for 5 weeks night & day, then 50°F. night—80+°F. day	20.28	7.30	100
50°F. for 6 weeks night & day, then 50°F. night—80+°F. day	21.40	7.23	101

[1] Forcing began January 9, 1962.

[2] Day temperature for control approximately 70°F.

flowering, flower number, number of nodes and flower size.

Results: The data, in general show that two weeks of 50° F. night temperatures at beginning of forcing are adequate to insure no significant reduction in bloom number (see Table 7 and Figure 5). Further, this temperature followed by either 60°, 65°, or 70° was satisfactory until flowering (Table 2 and Figure 6). Lower temperatures tended to increase plant height and bloom number; whereas higher temperatures decreased plant height and bloom number (Table 2 and Figures 6 and 7). There was no correlation between height and number of leaves, and flower size was not affected by temperature. Night temperature had more influence on plant height and days to maturity than did day temperature (Tables 7 and 8 and Figure 8).

As in the 1960 experiment, the most striking effect of temperature was on rate of growth. This was directly proportional

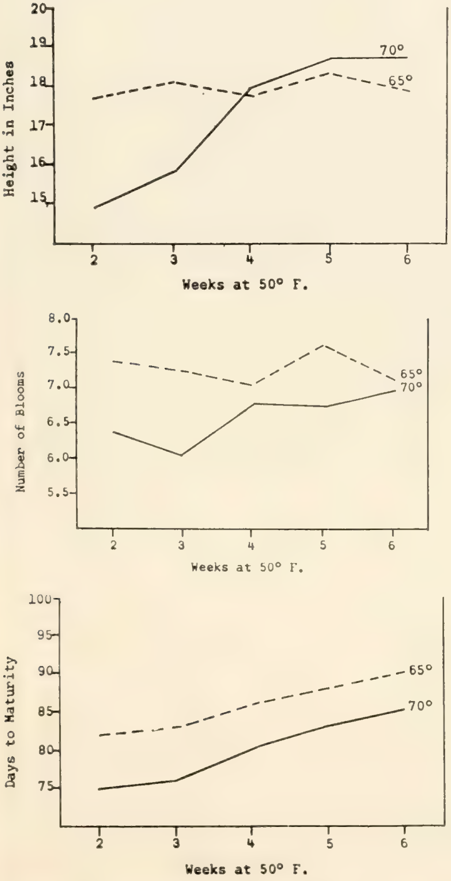

Figure 5. Effects of variations of time at 50° F. prior to raising temperature to 65 and 70° F. on number of blooms, height and days to maturity.

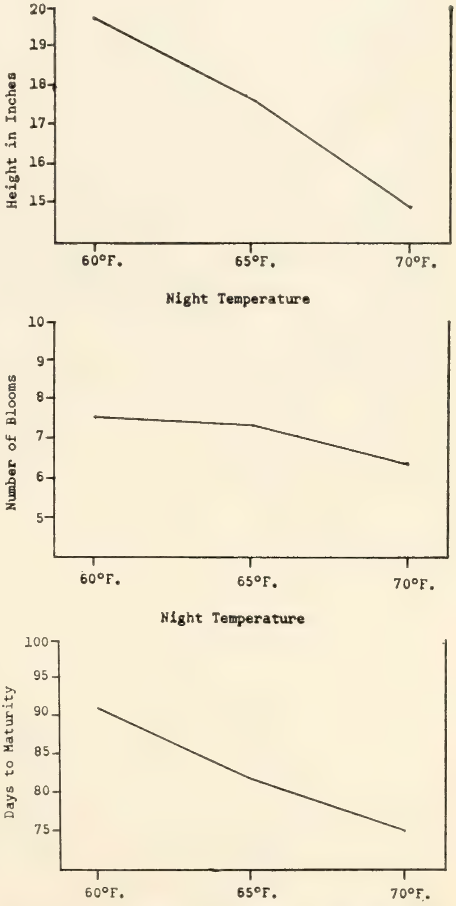

Figure 6. Effect of night temperatures after exposure to 50° F. for 2 weeks on height, bloom number and days to maturity of natural cooled Georgia lilies.

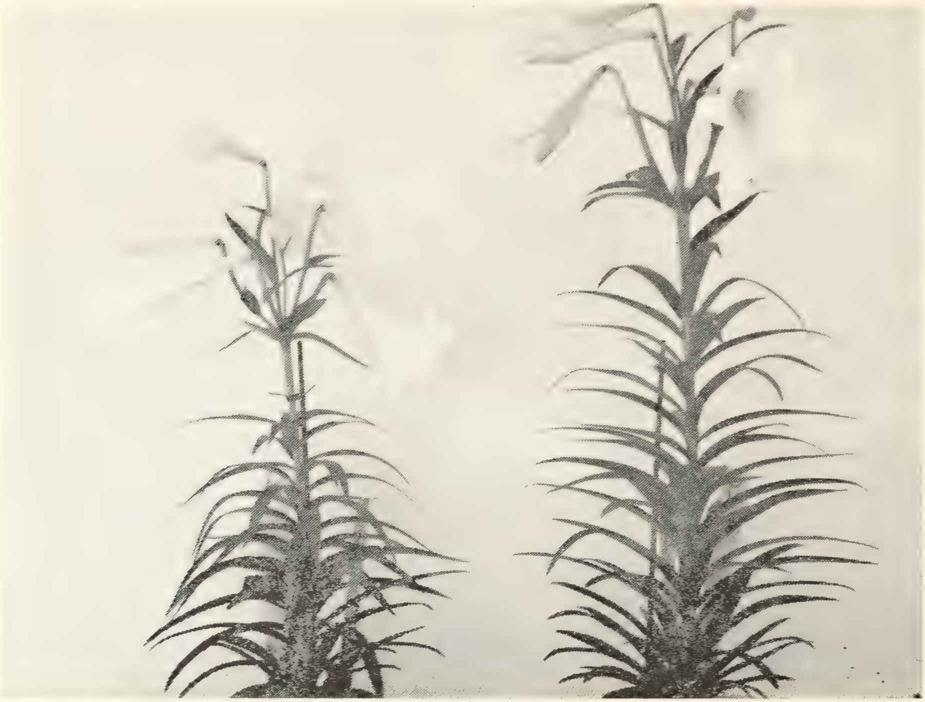

Figure 7. Georgia lilies natural cooled with beginning forcing temperature at night of 50° F. for two weeks. Following this, the plant on the left was forced at 70° night temperature and the one on the right at 60°. Note reduction of height and good bloom number of plant on left grown at higher temperature.

to temperature (Table 2 and Figure 6). In fact, this relationship was so exact that a mathematical formula can be applied to predict flowering dates with any given temperature. On the other hand, with a given number of days within which to grow the plants, the necessary temperature can be determined mathematically. However, this is presently limited to one group of biological data and thus restricts practical application. This is due to a lack of information on the "threshold" temperature (when the plant begins to grow) and to variations from one year to the next of temperatures during the natural cooling period. With this information, it is conceivable that a grower need only record those uncontrolled temperatures during the natural cooling period, begin forcing on the same date each year and mathematically determine the necessary forcing temperature for flowering on any given date.

This study tends to nullify the earlier conceived notions of forcing lilies which were based on calendar and to promote the conception of accumulated degrees above a 'threshold" temperature for growth. In addition, it explains why "timing" continues to be a major problem.

Plastic House Experiment

In the early fall of 1961 a study was begun on performance and cost of production of Georgia lilies in a conventional plastic house with ground beds. The house selected is shown in Figure 9 and was a pipe frame, quoinset type, which measured 20 X 60 feet. It was heated with forced air, gas fired heaters thermostatically controlled. The house was also equipped with a ventilating fan and automatic louvers.

Approximately six inches of unaged sawdust was spread evenly in the house with tile and gravel drainage provided. On September 3, 1,191 bulbs (5-6" size) were potted in 5-inch clay pots. These were spaced 10 x 10 inches immediately upon potting and were plunged to the rim in the sawdust (Figure 3).

The house remained uncovered until November 25, at which time 6-mil polyethylene film was placed on top. The ends of the house were not closed until December 30. At this time thermostats on the heaters were set at 30° F. and the ventilator fan at 40°. On January 11 (one hundred days before Easter) the heater thermostat was reset at 60° and the fan thermostat at 70°.

Records were maintained on cost of operations and on performance. From potting until forcing the plants required irrigation approximately twice each week and during the forcing period it was necessary to irrigate daily. They were fertilized twice with a moderate application prior to forcing and weekly during the forcing period.

The estimated cost of production is presented in Table 9.

The plants averaged 15 inches in height with 7 blooms. Figure 10 shows a typical plastic house grown plant. This bloom number was comparable to plants grown in glass houses; however, the height was markedly less. The reason for height reduction is speculative but is believed due to light quality and/or intensity.

Recommendations Based on Results

1. Pot bulbs immediately upon arrival (5-inch bulbs up may be used; however, the smaller sizes are generally quite sat-

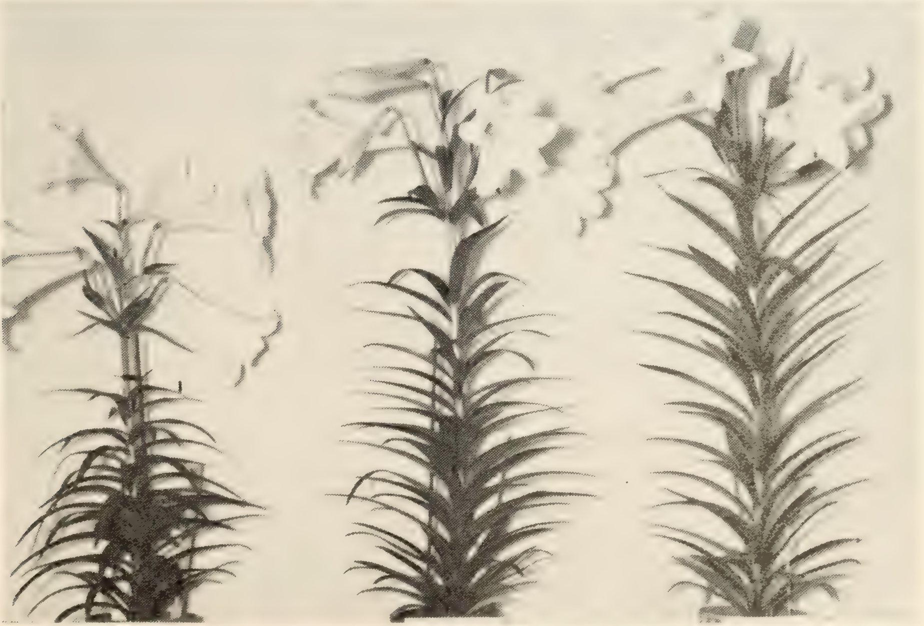

Figure 8. The plant on the extreme left was subjected to a high night temperature of 70° F. with moderate day temperature while the one on the extreme right was subjected to a moderate night temperature (50°) and a high day temperature of 80° which illustrates that night temperature is more effective on height. Center plant was forced at 60°.

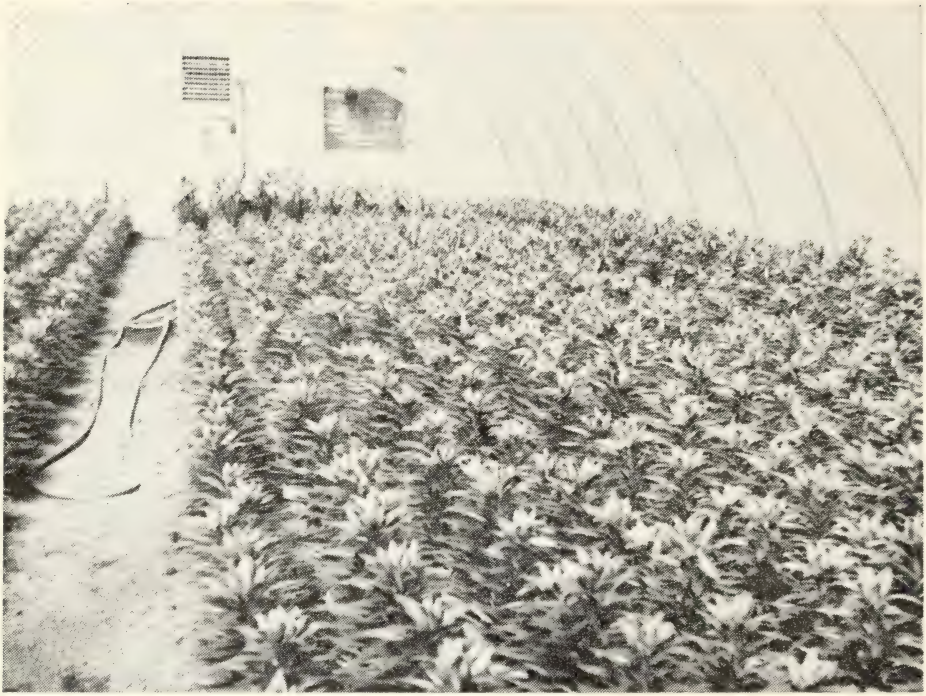

Figure 9. Georgia lilies natural cooled in plastic house and being forced in the same location. Growing on soil and mulched with sawdust.

isfactory and height is more desirable (Figure 12). It is desirable to treat bulbs with two pounds each of Terrachlor and Captan per 100 gallons of water. Pots should be 5 ½ inches in size. A well drained soil is necessary; however, some clay-type soil is preferable to a sandy soil due to buffer capacity. Sandy soils tend to leach and nutrients, especially calcium, are lost. In addition, pH may be lowered All of this tends to intensify root rot problems. The potting soil should be analyzed prior to potting and the pH adjusted to 6.5 to 7.0. Subsequent analyses are desirable. In addition, potting soil should be treated either with steam or some chemical such as methyl bromide or vapam.

2. Place pots outside on soil in a well drained, **sunny location,** "pot to pot",

Table 9.—Estimated cost of production of Georgia lilies produced in a plastic greenhouse.

Labor — (man hours at $1.00/hr.)	169 hrs.	$169.00
a. Hauling and spreading sawdust	20 hrs.	
b. Potting and plunging	39 hrs.	
c. Irrigating fertilizing and spraying	88 hrs.	
d. Installation of plastic film	12 hrs.	
e. Miscellaneous (weeding, turning etc.)	10 hrs.	
Bulbs (5-6" size, 1,191 at $0.15 ea.		$178.65
Pots (1,191 5-inch clay) at $0.07 ea.		$ 83.37
Heat (natural gas) January through April		$ 82.56
Plastic film		$ 30.00
	Total	$543.58
Cost per plant		$ 0.46[1]

[1] Does not include soil cost, its preparation, cost of water, electricity, fungicides and insecticides.

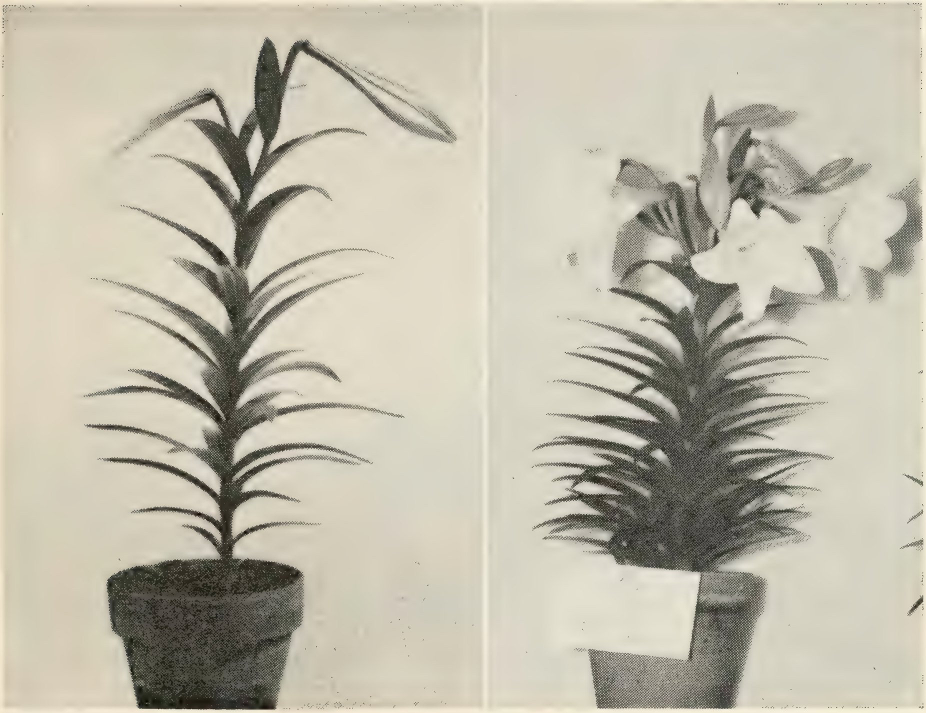

Figure 10. Georgia lilies, 6-7 inch bulbs grown in plastic house. The plant on the left is from a pre-cooled bulb, while that on the right is from a natural cooled bulb. Note differences in compactness of foliage and bloom number.

and fill around and between pots with sawdust up to the pot rims. Coldframes are not satisfactory due to shade. Covering over rims with sawdust delays emergence and should be avoided. Sawdust may be eliminated in mild areas; however, more frequent irrigation might be necessary. Do not plunge in sawdust during the forcing period.

3. Irrigate immediately upon potting and continue as needed throughout the natural cooling and forcing period. Moisture is a critical factor and the soil should not be allowed to become dry.

4. Fertilization should begin as soon as plants have emerged. Fertilize about every three weeks until forcing begins and then once each week until flowering. A complete fertilizer should be used unless phosphorus is incorporated in the potting soil. Calcium nitrate and potassium chloride or potassium nitrate are recommended as sources of nitrogen and potassium.

5. Provide temporary protection, several inches above the pots, while natural cooling by covering the plants with plastic, muslin or some other material. Cover only at night when the temperature is expected to drop below 30° F. Remove the cover immediately in early morning. Should a plastic house be used for natural cooling and forcing, plants may be plunged in sawdust at spacing recommended for "finishing" them. The plastic would be installed and heat supplied as described previously in this paper. Otherwise, treatment would be the same as if natural cooled outside. Some temporary, supplemental heat is recommended if temperatures drop below 15° F.

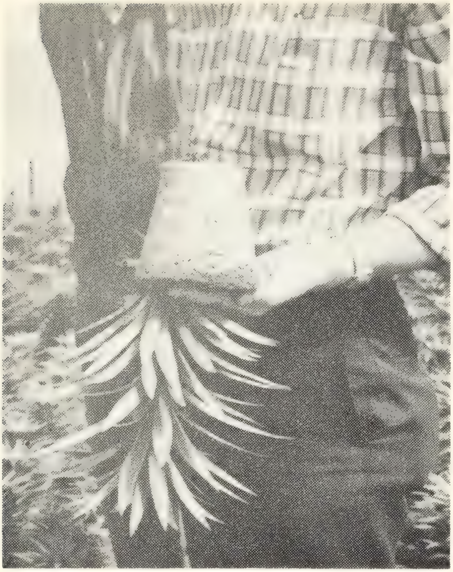

Figure 11. Natural cooled Georgia lilies growing in a plastic house. Note the excellent root system at this stage of growth which is believed to be a major contributing factor toward excellent quality achieved by the natural cooling method.

6. Keep house humidity down as much as possible during forcing, even by using extra heat and ventilation. This will aid in control of Botrytis should it become a problem. Thiram spray is also beneficial

7. For short, compact plants maximum light intensity is necessary.

8. **Accurate temperature, especially at night is extremely important to insure blooming for Easter.** Don't guess; use a maximum-minimum thermometer and **hang the thermometer at plant level.**

9. Research currently in progress should, in time, provide the necessary information for accurately predicting forcing temperatures year after year with forcing beginning always on January 1, regardless of Easter dates. This will alleviate the space problem which is acute during the Christmas season. However, in the absence of this necessary information, it is now recommended that forcing begin 90 days before Easter if a temperature of 60° F. is to be maintained, 85 days before with a temperature of 65° and 80 days before with a temperature of 70°. All should have transition temperatures of 50° for two weeks, and the latter two should have an additional conditioning period of one to two weeks at 60°. Temperatures above 70° are not recommended due to increased bud loss. There are three precautions:

a. Use a recording thermometer—**don't guess at the night temperature**

b. Begin forcing 10 days earlier if plants are grown under plastic (it is believed that the difference is caused by a lower day temperature under plastic where ven-

c. Remember that higher temperatures reduce plant height. This is desirable under glass but might not be under plastic.

10. The grower should observe the plants and use the rough guide below to determine whether or not his plants are on schedule:

6 weeks before Easter — Buds just showing

4 weeks before Easter — Buds just before bending

3 weeks before Easter—Buds bent down

2 weeks before Easter—Buds approaching back to horizontal and whitening

1 week before Easter — Blooms

If the plants get ahead or behind by the guide, increase or decrease temperature to adjust to schedule. Do it by the day per week timing, i.e.:

50 to 60° F. 1 day gain per week

60 to 65° F. 1 day gain per week

65 to 70° F. 1 day gain per week

70 to 75° F. probably about 1 day gain per week

Dropping the same interval adds the same number of days to maturity.

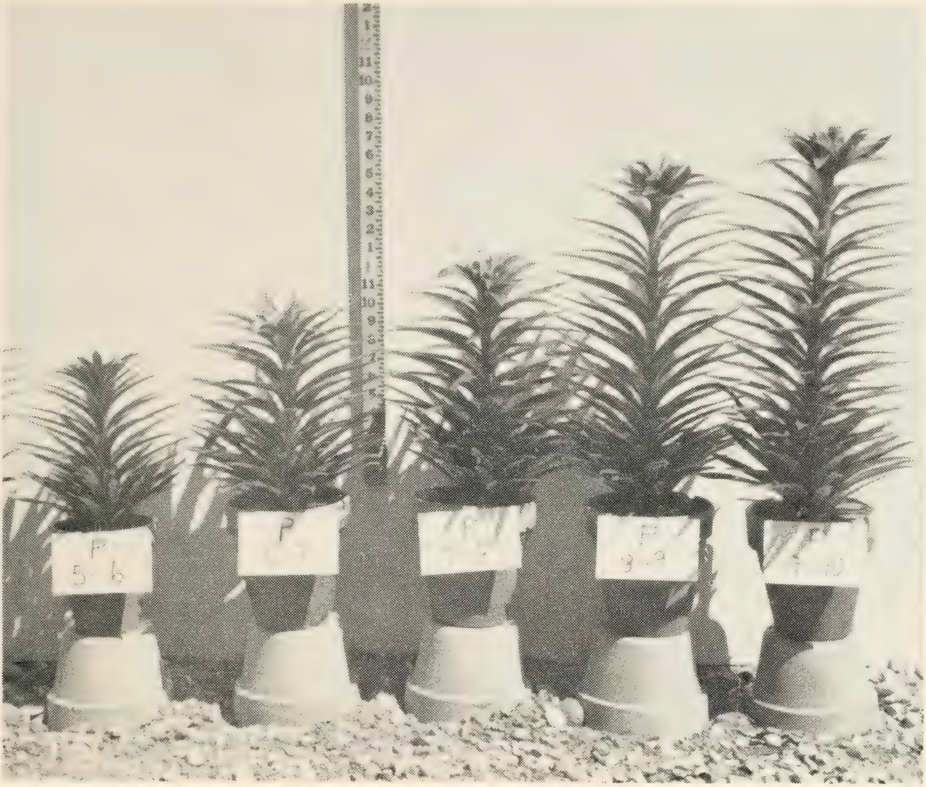

Figure 12. Plants from bulb sizes, L to R: 5-6 inch, 6-7 inch, 7-8 inch, 8-9 inch and 9-10 inch. Note increasing height as size increases.

BULLETIN 676 NOVEMBER 1963

Head Lettuce Production

By DAN A. AULTMAN AND STEVE L. WINDHAM

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Head Lettuce Production

By DAN A. AULTMAN AND STEVE L. WINDHAM

Copiah County has a total of 2035 farms of which 1055 are less than 80 acres in size. These conditions are also present in several other counties in the State. Diversification is absolutely essential for these farms. Lettuce will fit into such a program. It grows at a time of the year when very few other row crops are grown and harvested.

The estimated acreage planted to lettuce in the United States for 1959 was 233,000 acres, of which 6,700 acres were planted in Florida, Georgia, North Carolina, and South Carolina.

Tests at the Truck Crops Branch Experiment Station show that lettuce can be grown successfully during late winter and early spring. Lettuce grown on this Station and in the surrounding area has been well received by the local market. This crop provides an opportunity for the truck and market gardener to supply his local community with high quality lettuce during April.

This report sets forth the recommendations based on experiments and observations at the Truck Crops Branch Experiment Station for successful production of lettuce.

Climatic Requirements

Lettuce is a cool season crop that will withstand all frosts and most freezes which occur in Mississippi. However, temperatures below 16 degrees F. at certain critical stages of plant development will severely damage if not kill the plants. Plants are most likely to be killed when in the seedling stage or when they are succulent due to very favorable growing conditions. Cool temperatures are essential from the time head development begins through the harvest period. Erratic occurrences of high and low temperatures do not favor the development of high quality heads. The most ideal temperature for head development is a mean of 52 to 62 degrees. A few days of temperatures above 80 degrees during April favor the development of tipburn, slime, and flower stalk formation.

Lettuce is sensitive to any great change in the availability of soil moisture. It needs a uniform supply throughout its growth to insure uninterrupted development. This is particularly true during head development and extends throughout the harvest period.

Varieties

Until 1942 it was almost impossible to produce high quality lettuce in many parts of the South because of poor varietal adaptation. At this time a new variety was released under the name of Great Lakes. This variety had good resistance to tipburn and a high degree of resistance to flower stalk formation which is initiated by high temperatures and long days. Today there are many strains of the Great Lakes which have largely replaced the original variety. The results of variety and observation tests show that Great Lakes strains 118, 200-A, 366-A, and A-36 are well adapted to normal late winter and early spring temperatures in Mississippi.

The above strains, as shown in Figure 1, produce good firm heads, maintain good tipburn resistance, and are slow to develop flower stalks inside the head. Normally a grower can expect to market 60 percent or more of the total planting and may expect an average head weight of 1.6 to 1.9 pounds.

Plant Production

Lettuce may be established in the field by direct seeding or grown in a plant bed and later transplanted into the field. However, tests and observations over a number of years point out that transplanting reduces the danger of crop failure during

Figure 1. A strain of Great Lakes just prior to harvest produced at the Truck Crops Branch Experiment Station.

winters when early freezes are severe enough to kill the young plants and is the most dependable method for establishing the planting.

There are two methods of producing transplants in this area: (1) in an unprotected plant bed, and (2) in a coldframe. The unprotected plant bed is similar to a coldframe except no provisions are made to protect the plants from frost or freezes during the time they are grown prior to transplanting.

The unprotected plant bed is a reliable method when normal temperatures prevail in November and December. It is the least expensive method and generally more uniform and healthier plants are produced in open beds than when grown in a coldframe (Figure 2). However, an early freeze may occur that is severe enough to injure the plants. Thus it is recommended that a portion of the total plants needed each year be grown in coldframes. This may prevent a total crop failure due to lack of plants.

When preparing the plant bed apply 15 pounds of 13-13-13 fertilizer per 500 square feet of area. Incorporate this fertilizer into the soil when shaping the bed. To prevent diseases and weeds the beds may be sterilized with Vapam, Mylone, or Bedrench.[1] Follow the manufacturer's recommendations printed on the label for applying the material and observe the caution for handling and storing these chemicals.

The seed may be sown either broadcast or in rows. Three-inch row spacing is desirable in the coldframe and six inches in an unprotected plant bed. After 10 days it is necessary to thin to a single plant 2½ to 3 inches apart in the coldframe so as to give each plant 6 to 9 square inches of bed area. Less thinning is required in the unprotected plant bed. Unless it is absolutely necessary, spindly or leggy plants should not be used as these plants require a longer period to establish a root system, have less tolerance to low temperatures, and head development is not as early as for well developed plants.

Soils and Fertilizer

Lettuce will grow on a wide range of soils. The best soil is a deep loamy soil that has good internal drainage and is well supplied with organic matter. Sandy soils that are low in organic matter and soils

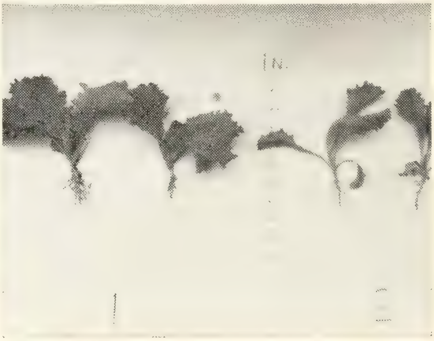

Figure 2. Plants grown in outside bed (1) are stockier, larger, and have better root system than plants grown in protected coldframe (2).

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[1] Trade names of material manufactured by E. I. DuPont de Nemours and Company, Union Carbide Chemicals Company, and Food Machinery and Chemical Corporation.

that become too wet or too dry due to poor physical structure should not be used.

On soils low in organic matter an application of 10 to 15 tons of barnyard manure per acre should be a yearly practice. Regardless of the type of manure used it should be turned under well in advance of transplanting in order that decomposition can take place.

A soil test should be made to determine the amount of fertilizer and lime required before buying any fertilizer. Lettuce requires a complete fertilizer and a soil reaction of pH 6.0 to 7.0. In the absence of a soil test 72 pounds of available nitrogen, 96 pounds of P_2O_5, and 96 pounds of K_2O should be applied per acre prior to planting. Sidedress with 32 pounds of available nitrogen per acre at the time the leaves begin to cup in the first stage of head formation.

Land Preparation and Transplanting

Land preparation and fertilizer application should take place at least two to three weeks prior to transplanting. The soil should be pulverized as deep as possible without turning up raw subsoil with normal breaking equipment. Fertilizer is applied in single bands in the center of the row and bedded upon. Fertilizer placement should be at a depth of at least two to three inches below the root area of the plants at transplanting. The overall row height should be such that a height of at least 4 to 6 inches is maintained after the last harrowing prior to transplanting. If winter weeds or if soil crusts occur prior to transplanting the rows should be disced and harrowed, just prior to setting.

Plants should be spaced 12 inches apart on rows 36 to 42 inches wide. The width of row is generally determined by available equipment. Plants may be set by hand or by a special transplanter. In either case soil must be firmed around the roots and care taken to prevent coverage of the terminal bud with soil during transplanting. If the soil is dry when the plants are set the field should be irrigated as soon as the farm operations permit.

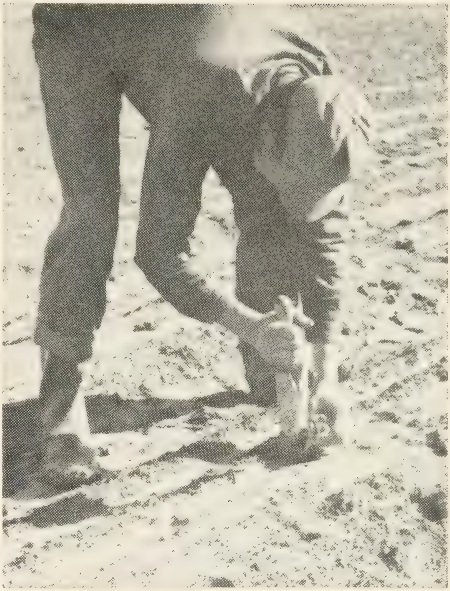

Figure 3. Setting lettuce by hand.

Cultivation

Lettuce is grown during a time of the season when soil and air temperatures are not favorable for rapid weed germination or growth. Normally lettuce requires only two cultivations. The crust of the soil is broken and mulch maintained by shallow cultivation about three weeks after transplanting. The second cultivation is performed at the leaf cupping stage when additional nitrogen is applied as a sidedressing. The crusting of the soil by rain or conditions favorable for weed growth may result in a need for additional shallow cultivations.

Irrigation

Lettuce needs a uniform supply of soil moisture throughout its growth. It can be grown without irrigation but poor production may result because of low rainfall during critical periods of development. Young plants that are retarded because of insufficient water will be late in maturing heads. If plant growth is not uniform throughout head development due to moisture fluctuation, maturity is delayed, heads may burst, and tipburn will be more severe, all of which result in poor quality heads.

From time of transplanting to sidedressing the plants should not be allowed to go more than 12 days without water. At the time head development begins and throughout harvest the plants should not be allowed to go longer than 8 days without water. Water should be applied at a rate of 1½ to 2 acre inches per application. When water is applied just prior to and during the harvest season and temperatures exceed 80 to 85 degrees F. it should be applied early in the morning while the plants are cool and before wilting begins, otherwise an increase in tipburn and slime may result. Rains during hot weather may have the same effect.

Crop Rotation

Lettuce is susceptible to soil borne disease which can live over in the soil from year to year. If lettuce is grown continuously on the same location these diseases will build up in the soil to a point where the crop becomes unprofitable.

Several other advantages also justify this plan of rotation. When animal manure is not available using a green manure crop may fit well into a crop rotation program. However, crop rotation should be a standard practice in order to keep soil borne diseases under control.

The crops that may be used in a rotation program with lettuce are: alfalfa, clovers, wheat, soybeans, rye, vetch, cowpeas, beets, cucumbers, melons, onions, pumpkins, radishes, spinach, sweet corn, and tomatoes. These crops are not susceptible to the same diseases that attack lettuce and will not serve as a host plant for lettuce diseases.

Insects

Plant injury and loss from insects and diseases has not been a major problem at the Truck Crops Branch Experiment Station. However, the insects and diseases that have been observed attacking lettuce at this Station and their control are discussed briefly in this section.

Cutworms: The cutworm can become a problem after the plants have been transplanted to the field. An application of 10 to 20 pounds of 20 percent toxaphene per acre to the top of the row before setting or just after setting the plants will control this insect.

Aphids: One infestation of lettuce by aphids has been observed at this Station in the past eight years, but lettuce is susceptible to being attacked by aphids at any stage of plant growth.

To control aphids apply 1 percent parathion dust at the rate of 10 to 20 pounds per acre, or ¼ to ½ pounds of active liquid formulation in 50 to 100 gallons of water per acre. Discontinue using parathion 21 days before harvest. Malathion, 4 percent, dust applied at the rate of 10 to 20 pounds per acre, or ¼ to ½ pound of active liquid material in 50 to 100 gallons of water per acre may be used 5 days before harvest. An application of 2 percent phosdrin dust, or ¼ to ½ pound of active material in liquid formulation in 50 to 100 gallons of water per acre may be used Phosdrin can be applied 48 hours before harvest.

Cabbage Worms: These leaf eating worms can be controlled by applying 2 percent phosdrin dust at the rate of 10 to 20 pounds per acre, or by the application of ¼ to ½ pound of active material in 50 to 100 gallons of water per acre

WARNING: Many insecticides are highly poisonous to man and animals The directions on the label MUST BE followed.

Diseases

The major diseases of lettuce are (1) damping-off, (2) bottom rot, (3) drop, (4) tipburn, and (5) slime.

Damping-off: Damping-off may become a problem in the coldframe or in unprotected plant bed during prolonged periods of warm wet weather. It may attack plants in the field but is primarily a disease of the plant bed. Preventive measures consist of thinning and ventilating the plants for good air circulation so as to dry the soil around the base of the plants.

Bottomrot: Bottomrot, which may be a problem during warm wet weather, is produced by an organism that causes damping-off. Bottomrot may be severe during wet warm weather and disappear when the soil dries out. To control bottomrot rotate lettuce with corn or any other crop that is not attacked by the organism and use only land that is well drained.

Drop: Drop attacks the plants during cool moist weather. It usually attacks mature plants and may become a serious problem. Very young plants affected by the disease wilt and die rapidly. In mature plants the symptoms vary. In some cases the plant may wilt down in a slimy mass or it may begin wilting gradually. An examination of the stem at the soil line reveals water soaked spots. No effective way to eliminate the drop organism from the soil has yet been found. More plants are lost in the fields that are too wet. Care should be taken to keep the tops of the rows as dry as possible.

Tipburn: Tipburn is a brown-dry dead area on the margin of the leaves inside the head and provides an excellent source of infection by the rot producing organisms which causes slime of lettuce. Tipburn is thought to be a physiological condition within the plant and several factors have been found to increase the occurrence and severity of tipburn: (1) rapid succulent growth, (2) high temperatures as well as humidity, (3) fluctuation or inadequate soil moisture.

The control of tipburn consists of planting tipburn resistant varieties. Use only vigorous stocky plants that will head rapidly when spring temperatures become warm enough for growth, maintain a uniform supply of soil moisture, and set the plants in the field by January 27 so they will mature before hot weather occurs.

Slime: Slime is a serious problem accounting for a large portion of unmarketable heads during the last of the growing season at this Station. It may be caused by bacteria or fungi in the soil or on the plants. In order for these causal agents to infect the plant it must have some means of entering the plant tissue. Since they are not able to attack healthy sound tissue their entrance is through damaged tissue caused by tipburn, mechanical or insect, salt burning, sunburning, frost, other disease and spray injuries. The control of this disease is by carefully attending to the best practices recommended for the production of lettuce.

Harvesting and Packing

Only experience can teach a grower when lettuce is ready for harvest. The heads should be reasonably firm but not hard. An inexperienced cutter will have to guard against cutting heads that are too loose. It is essential that the heads be harvested as soon as they reach maturity. Any delay in harvest increases the danger of disease, insect and head bursting. Lettuce planted between January 15 and 25 will have some marketable heads ready to cut around April 9. The grower should begin inspecting his crop for mature heads during the first week of April. Earlier planted lettuce grown during a mild winter may produce heads the first week in April. Lettuce that is to be sold to local stores or nearby markets should be cut early in the morning while the heads are cool. However, the heads should be handled carefully because the leaves are easily broken and crushed when the heads are cut before the plant has wilted.

During the harvest of the heads the plants stem is cut at the ground line. The stem is trimmed, and dead, diseased, or broken outer leaves are trimmed off to make an attractive head. Leave about four of the older outer leaves on the stem They will serve as wrapper leaves to protect the head until it is placed on the display counter at the store.

The containers in which the heads are to be packed should be located in convenient places in the field. The heads should be packed in the containers as soon as possible after having been cut and carried to a cool place until a load has been harvested. Lettuce should move from the field to the market in the shortest time possible in order to preserve the fresh field quality.

The type of container a producer will use and the method of packing the heads will be determined by the specifications of the market on which the lettuce is sold.

BULLETIN 677 DECEMBER 1963

Castorbean Production In The Mississippi Delta

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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Conclusions

Extremely high yield losses from capsule drop during the period of 1957 through 1962 indicate that this disease must be controlled if castorbeans are to become a commercial crop in the Mississippi Delta and surrounding area. The development of disease-resistant varieties is considered the best method of controlling this disease. It is believed that resistant varieties may be available in the near future.

Early harvesting, before capsule drop causes severe yield losses, may be a satisfactory method of controlling this disease and producing this crop. By chemically desiccating and harvesting castorbeans in late September or October, satisfactory yields of over 2000 pounds of seed per acre were obtained in most tests from 1959 through 1962. It is suggested that selecting a high-yielding variety or hybrid and desiccating before capsule drop causes severe yield losses may be a profitable method of producing castorbeans in the Mississippi Delta and surrounding area until resistant varieties are available.

Producers should make definite arrangements to harvest and sell the crop before planting castorbeans.

Table 1.—Yields of 24 varieties and hybrids of castorbeans harvested from border and yield rows on different dates at Stoneville, Mississippi, in 1959.

Variety or hybrid	Average yield (pounds of seed per acre)				Yield losses from capsule drop (%)
	Border rows harvested by			Yield rows harvested	
	8/12	8/27	10/26	11/12	
T58081	1707*	2298*	2475*	1419*	57.3
T58078	1700*	1958*	2006	920	54.1
T58082	1491*	1901	1971	675	65.8
T58085	1497*	2141*	2309*	1262*	45.3
T58087	1436*	2101*	2346*	1399*	40.4
T58079	1280	2156*	2278*	1085*	52.4
T58086	1231	2011*	2134*	1413*	33.8
T58088	1226	1817	1994	994	50.2
T58094	1165	2056*	2289*	790	65.5
T58098	1132	1801	1967	834	57.6
T58093	1074	1863	2130*	653	69.3
T58089	1067	1768	1947	599	69.2
T58089	1047	1602	1748	646	63.0
T58092	1030	1752	1954	788	59.6
T58095	1005	1708	2028	650	67.9
T58097	907	1776	2016	1041*	48.4
T58080	891	1842	1998	1022*	48.8
T58096	859	1745	1931	716	62.9
T58084	783	1768	2104*	1039*	50.6
T58083	736	1675	1879	839	55.3
Baker 296	672	1382	1717	1366*	20.4
Dawn	640	916	1043	656	37.1
Baker 147	611	1378	1656	922	44.3
Interspersed Dawn	499	931	1105	762	31.0
Average	1070	1764	1959	922	52.9
LSD (5%)	303	359	372	422	......
Coefficient of variation, %	20.1	14.4	13.5	32.4	......

*Not significantly different from highest yielding hybrid or variety.

CASTORBEAN PRODUCTION IN THE MISSISSIPPI DELTA

By THOMAS W. CULP[1]

High yields of castorbeans in 1956 variety trials at Stoneville, Mississippi, indicated that this species is potentially a promising new oilseed crop for the Mississippi Delta and surrounding area. Diseases were not a problem that year and 415 hybrids produced an outstanding yield, 3693 pounds of seed per acre. The average yield of 14 varieties and hybrids was 2793 pounds of seed per acre.

These high yields stimulated much interest in this crop, and Delta farmers planned to plant approximately 1000 acres of castorbeans in 1957 and 1958. Only 100 acres were planted each season because of extremely wet weather at planting time. This was most fortunate because diseases of castorbeans practically destroyed commercial plantings during these two seasons.

Destructive Disease

Capsule drop,[2] and possibly other fungi, proved to be the most severe disease of castorbeans and the limiting factor in the production of this crop in the Mississippi Delta. It was estimated that this disease reduced yields in variety trials by 70 and 85% in 1957 and 1958, respectively. It is apparent from these data that capsule drop must be controlled if castorbeans are to become a commercial crop in the Mississippi Delta and surrounding area.

Capsule Drop Resistant Varieties

The most promising method of controlling capsule drop is the development of disease-resistant varieties of castorbeans. In 1957, it was noted that the variety Baker 296 possessed a high degree of resistance to this disease. MW-1, an ornamental strain which retained its seed throughout the fall and winter, was found near Clarksdale, Mississippi, in March 1958. This line proved to possess a greater degree of resistance to capsule drop than other lines tested. Since Baker 296 has not consistently produced satisfactory yields and MW-1 is a very tall normal-internode line, they were not suited for commercial production in this area. Therefore, it became necessary to transfer the resistance exhibited by MW-1 and Baker 296 to more productive dwarf-internode lines.

Crosses to transfer capsule drop resistance to productive dwarf-internode castorbean lines were made in 1958 and 1959. Progenies from these crosses have been most promising for yield potential and resistance to capsule drop. Experimental lines of the F_4 and F_6 generations of these crosses were first compared in a preliminary variety trial in 1962. Variability was very great in this test, but 5 experimental lines produced statistically greater yields than Baker 296. The highest yielding line produced 2801 pounds of seed per acre. A total of 42 of the 154 selections produced yields numerically equal or greater than that of Baker 296, which produced 1278 pounds of seed per acre.

Although capsule drop was not a major problem in most castorbean plantings in 1962, yield losses in this test were high because the plants were killed by cotton defoliants in October. It was estimated that Baker 296 lost 24.4% of its seed from capsule drop.

This estimate was obtained by harvesting half of each plot as the seed matured in October and November with only minor losses from capsule drop. The remaining half of each plot was harvested in December in the usual manner

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[1] Research Agronomist, Crops Research Division, Agriculture Research Service, U. S Department of Agriculture, in cooperation with the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississippi

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[2] Caused by *Alternaria ricini* (Yoshii) Hansf

of waiting until the plants were killed by frost. The difference in yields of these 2 harvests was attributed to losses from capsule drop. A total of 51 of the 154 selections lost no more seed than Baker 296, and 14 selections lost less than 10% of their seed from capsule drop.

These data indicate that varieties superior to Baker 296 in yield and capsule drop resistance should be developed from these experimental lines in the near future.

Early Harvest

Other methods of controlling capsule drop of castorbeans have been investigated, and the most promising of these methods is harvesting before this disease becomes a major problem. The first indication that early harvesting might be a method of controlling capsule drop of castorbeans was obtained from the yields of border rows harvested in a yield test at Stoneville, Mississippi, in 1959. Border rows were harvested on August 12, 27 and October 26 to obtain yield estimates without losses from capsule drop.

Harvesting on August 12 is too early for satisfactory yields; however, one hybrid produced 1707 pounds of seed per acre (Table 1). Very acceptable yields of about 2000 pounds of seed per acre were obtained with 7 hybrids, and most of the other varieties and hybrids produced satisfactory yields of over 1600 pounds of seed per acre when harvested on August 27. These yields represent 90% (range = 80.5 to 97.6%) of the total yield of border rows obtained by October 26.

Greater yields of 64.9% (range = 15.2 to 127.6%) were obtained by harvesting on August 27 rather than by waiting until the plants were killed and dried by frost on November 12 (the usual method of castorbean harvest). When the yields of border rows harvested by October 26 are compared with the yields of plot rows harvested on November 12, 52.9% (range = 20.4 to 69.3%) less seed were obtained on November 12, primarily because of losses from capsule drop. Therefore, higher yields were obtained with all varieties and hybrids by early harvest on August 27.

Stands were not as good and castorbeans suffered from lack of moisture in 1960; however, data were obtained that support the results of 1959. Border rows of the 1960 Regional Castorbean Yield Test were harvested first on September 21. The highest yielding variety produced 1992 pounds of seed per acre. This yield was not significantly different from that of the other varieties and hybrids. The average yield of all varieties and hybrids was 1525 pounds of seed per acre.

These yields represent 78.6% (range = 51.7 to 93.4%) of the total yield of border rows obtained by November 11. These values are lower than those obtained in 1959 because many of the 1960 entries flowered and set seed later in the season. However, higher yields of 37.9% (range = -39.6 to 128%) were obtained by harvesting on September 21 rather than by waiting until the plants were killed and dried by frost on November 11.

When the total yields from 2 harvests of border rows are compared with the yields of one harvest of yield plots on November 11, the varieties and hybrids lost an average of 38.9 (range = 14.3 to 62.5%) in yield, primarily from capsule drop. This value was smaller than expected because the resistant varieties MW-1 and Baker 296 were included in this test. Yields of all susceptible varieties were much greater when castorbeans were harvested on September 21.

These data indicate that castorbean yields of about 2000 pounds of seed per acre may be obtained by selecting the most productive varieties or hybrids, desiccating, and harvesting before capsule drop causes severe yield losses.

Chemical Desiccation

Preliminary tests to compare the effectiveness of chemical desiccants and their application to castorbeans were initiated in 1960 in cooperation with R. O. Thomas[3]. Chemical desiccants[4] Diquat. L10, and Drop Dead, with 100 cc of the surfactant Colloidal X77, were applied at the rate of 2 pints per acre to kill and dry castorbeans for harvest. These chemicals were applied with a Hahn Hi-boy equipped with inverted-U defoliation booms to completely spray the plants.

The most effective plant coverage was obtained with an overhead system consisting of 3 flat fan-type herbicide nozzles (Spraying Systems No. 80001) and a horizontal system consisting of 4 (2 on each side of the row) flat fan-type herbicide nozzles (Spraying Systems No. 800067) per row. The spray volume was 15.45 gallons per acre when the machine was operated at 5 m.p.h. and the system was under 30 p.s.i. By use of this method of applying the desiccants, the castorbeans were usually dry and ready for harvest approximately 2 weeks after application.

Four tests were desiccated with these chemicals—two on September 21, one on October 3, and one on October 10. Most varieties produced satisfactory yields of 1500 to 2000 pounds of seed per acre. Diquat consistently dried castorbeans faster than the other chemicals and was considered to be the best desiccant under study.

When to Desiccate and Harvest

A study to determine the proper time to desiccate and harvest castorbeans for maximum yields without losses from diseases was conducted at Stoneville, Mississippi, in 1961. The 2 varieties Baker 296 and Hale were desiccated with Diquat

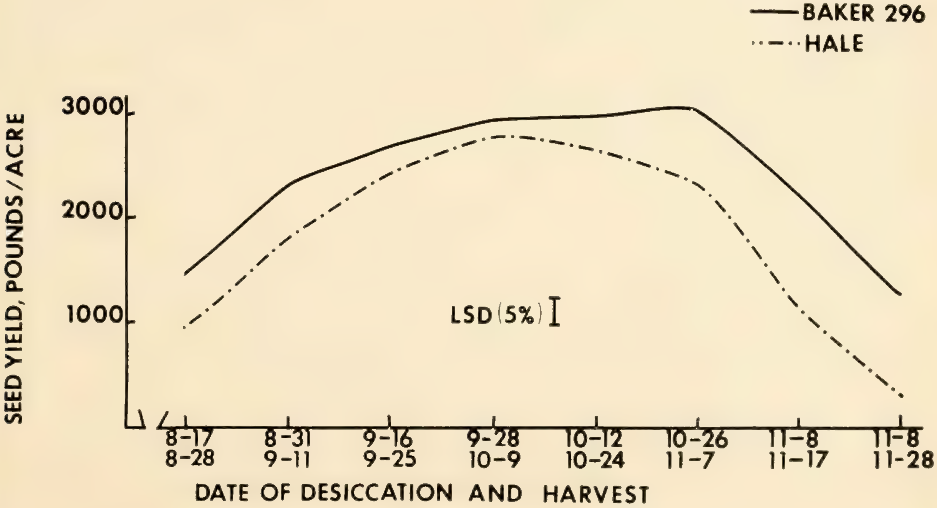

Figure 1. Yields of 2 varieties of castorbeans grown at Stoneville, Mississippi, and desiccated and harvested at various dates from August 17 through November 28, 1961.

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[3] Plant Physiologist, Crops Research Division, Agriculture Research Service, U. S. Department of Agriculture, in cooperation with the Delta Branch of the Mississippi Agricultural Experiment Station.

[4] Mention of commercial products or companies does not imply endorsement of or recommendation over others of a similar nature not mentioned. Diquat is 1:1 ethylene-2:2 dipyridylium dibromide. L10 is arsenic acid and sorbatol of which the exact chemical composition was unknown. Drop Dead is 25.2% pentachlorophenol, 3.6% other chlorinated phenols, 40% aromatic petroleum derivative solvent, and 31.2% inert ingredient.

at about 2-week intervals from August 17 through November 11. Baker 296 produced its highest yield (3096 pounds of seed per acre) when desiccated on October 26 and harvested on November 7 (Figure 1). This yield was not significantly different from the yields of 2969 and 2993 pounds of seed per acre, which were obtained when this variety was desiccated on September 28 and October 12 and harvested on October 9 and 24, respectively. Satisfactory yields of over 2000 pounds of seed per acre were obtained when this variety was desiccated as early as August 31 or harvested as late as November 17.

The late, susceptible variety Hale produced its highest yield (2829 pounds of seed per acre) when desiccated on September 28 and harvested on October 9. This yield was not significantly different from the yield of 2653 pounds of seed per acre obtained by desiccating on October 12 and harvesting on October 24. Satisfactory yields of 2460 and 2345 pounds of seed per acre were obtained when the plants were desiccated on September 16 and October 26 and harvested on September 25 and November 7, respectively. Yields were greatly reduced when this variety was desiccated and harvested before or after these dates.

These data indicate that excellent yields of both Baker 296 and Hale were produced by desiccating and harvesting in late September and October before capsule drop became a major problem. Susceptible varieties, such as Hale, can be produced satisfactorily by early harvest; however, the time when maximum yields can be obtained is limited to a few weeks. Resistant varieties, such as Baker 296, can be harvested much later in the season, thus eliminating some of the risk in harvesting the crop.

Capsule drop was a major disease problem at Stoneville, Mississippi, late in the 1961 season. The resistant variety Baker 296 lost very few seed before the plants were killed by frost on November 8. Reductions in yield after this date can be attributed primarily to capsule drop. On November 17 and 28 (9 and 20 days after the plants were killed by frost), Baker 296 produced only 2248 and 1271 pounds of seed per acre, respectively. (This was the time when it was impossible to machine harvest because of wet weather.) These data indicate that Baker 296 lost 27% and 59% of its seed from capsule drop during these periods.

Hale began to lose seed from capsule drop after October 9. Reductions in yield of 176, 484, 1711, and 2498 pounds of seed per acre were recorded when this variety was harvested on October 24, and November 7, 17, and 28, respectively. These reductions in yield of 6.2, 17.1, 60.5, and 88.3% can be attributed primarily to capsule drop. Much greater yields were obtained by early harvesting in late September or October.

Similar harvesting studies were conducted at Greenwood, Hollandale, and Stoneville, Mississippi, in 1962. Castorbeans were not chemically desiccated before harvesting. Capsules were harvested green and dried at about 120° F prior to hulling. Although yields were much lower during this season, results support the findings of 1961.

There were no significant differences in yields due to dates of harvest or varieties in the test grown at Greenwood, Mississippi. Average yields of Baker 296, Hale and Hale Hybrid ranged from 1209 to 1300 pounds of seed per acre when harvested at approximately 2-week intervals from September 15 through November 15 (Figure 2). These results indicate no reductions in yields from early harvesting.

The yields of the 3 varieties and hybrids were highly significantly different in the test grown at Hollandale, Mississippi. The early variety Baker 296 produced its highest yield of 1495 pounds of seed per acre when harvested on September 15.

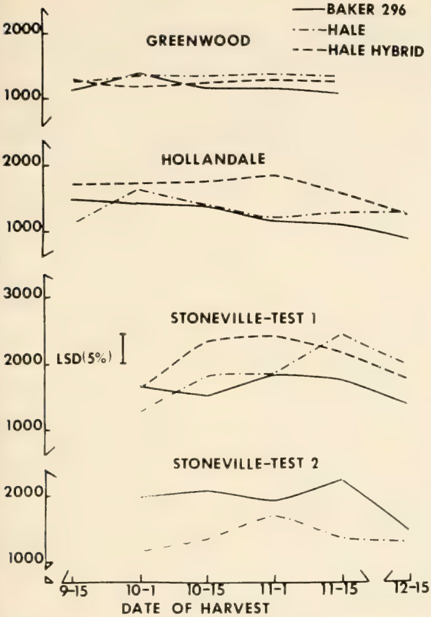

Figure 2. Yields of 3 castorbean varieties and hybrids grown at Greenwood, Hollandale, and Stoneville, Mississippi, and harvested at approximately 2-week intervals from September 15 through December 15, 1962.

Yields declined slightly with each progressive harvest. Hale Hybrid produced its highest yield (1721 to 1812 pounds of seed per acre) when harvested about every 2 weeks from September 15 to November 1. Hale produced its highest yield (1623 pounds of seed per acre) when harvested on October 1.

The first test at Stoneville, Mississippi, was planted on Bosket fine sandy loam on May 10, 1962. Baker 296 produced its highest yields, which ranged from 1500 to 1806 pounds of seed per acre, when harvested approximately every 2 weeks from October 1 through November 15 Hale Hybrid produced its highest yields, which ranged from 2168 to 2416 pounds of seed per acre, when harvested about every 2 weeks from October 15 to November 15. Hale produced its highest yields which ranged from 1972 to 2417 pounds of seed per acre, when harvested about every 2 weeks from November 15 to December 15. This variety produced satisfactory yields of about 1800 pounds of seed per acre when harvested on October 15 and November 1.

The second test at Stoneville, Mississippi, was planted on Dundee silty clay on May 9, 1962. Baker 296 produced 1898 to 2208 pounds of seed per acre when harvested about every 2 weeks from October 1 through November 15. Hale produced its highest yield of 1730 pounds of seed per acre when harvested on November 15. Yields were greatly reduced before or after this date of harvest.

When yields at different dates of harvest for all varieties at all locations are considered, yields of 1496 to 1610 pounds of seed per acre were obtained by harvesting about every 2 weeks from October 1 through November 15. Although Baker 296 may be harvested earlier than Hale and Hale Hybrid, satisfactory yields were obtained with all varieties by harvesting from September 15 through November 1. During most seasons, capsule drop causes severe yield losses after late October; therefore, yields obtained by harvesting on November 1 or later usually would be much less.

Results obtained in 1961 and 1962 suggest that a satisfactory crop of castorbeans should be produced by desiccating and harvesting in late September or October before capsule drop becomes a major problem. A late, susceptible variety such as Hale may be successfully produced; however, the period when maximum yields can be obtained is short. This apparently is true for all susceptible varieties; however, an earlier one such as Hale Hybrid can be expected to produce a greater yield and reduce the hazards of production.

Growing a resistant variety such as Baker 296 also greatly reduces the hazards of castorbean production in this area.

Baker 296 was harvested from October 9 through November 7 without appreciable losses in yield. This variety did not lose seed from capsule drop after being desiccated as readily as the susceptible varieties. It is expected that resistant varieties, when available for production, will produce most satisfactorily in this area if desiccated and harvested before the plants are killed by frost or before diseases become a major problem.

National Production

It is estimated[5] that the United States should be growing more than 150,000 acres of castorbeans annually to meet its needs for castor oil. In 1961 and 1962, approximately 27,000 acres of castorbeans were grown on the Great Plains and in the Far West. The production from this acreage supplies only 10 to 18% of the total annual consumption of more than 120,000,000 pounds of castor oil. In addition, better varieties and hybrids, mechanical harvesting and increased industrial demand for castor oil account for a more competitive position of castorbeans.

Grown Under Contract

Castorbeans are usually grown on a contract basis. There are no acreage restrictions or price supports and castorbeans are not in surplus. Before planting castor beans, a grower should make definite arrangements to harvest and sell his crop.

Seed Price

In 1962, the contract price at planting time in the Plainview area of Texas was 5.25 cents per pound on a clean-seed basis, delivered in Plainview. Market price at time of delivery was 5.08 cents per pound. Growers had the option of a fixed price (5.25 cents per pound) at planting time, or they could elect to receive the market price at time of delivery, with a guaranteed minimum of 5 cents per pound. Prices at other delivery points varied slightly according to differences in freight charges. Prices at East and West Coast plants ranged from 6.3 to 6.5 cents per pound over the past 3 years. Contracts for the 1963 crop assure the market price at time of delivery, but not less than 5 cents per pound.

Toxic Substances

Castorbean seed, as well as the pressed cake or pomace remaining after oil extraction, is poisonous to humans, livestock, and poultry. Toxic substances found in castorbeans are ricin (an albumin or poisonous protein), and ricinine (an alkaloid). The foliage, which is mildly toxic, contains only ricinine. Precautions must be taken in castorbean production and handling. Eating only one seed may produce nausea in humans and could be fatal.

Allergens (separate and distinct from the toxic compounds) also are found in the seed and pomace. Nearly 2% of the seed is composed of allergens, which may cause reactions in some people.

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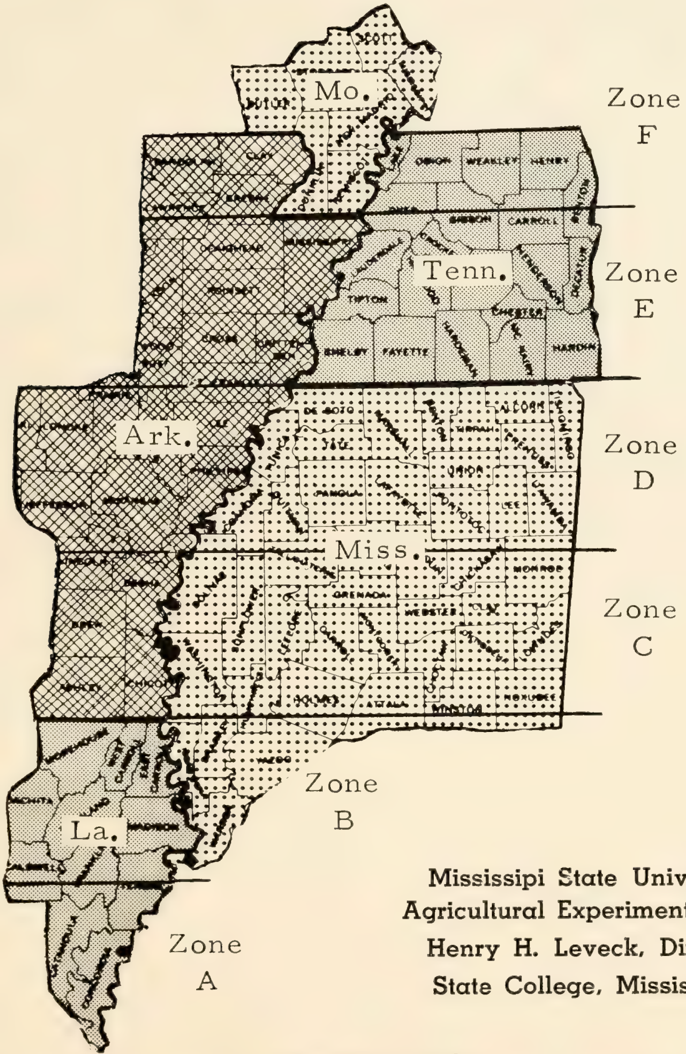
[5] Brigham, R. D. Castorbeans — Industrial Crop with potential. Crops and Soils 15:12-14. 1963

Brigham, R. D. Castorbeans — An industrial crop with a future. Texas Agricultural Progress 9:33-35, 1963.

BULLETIN 678 FEBRUARY 1964

Soil Temperatures And Cotton Planting In The Mid-South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in cooperation with
the U. S. Department of Commerce Weather Bureau and the Agricultural Experiment Stations and Cooperative Extension Services in Arkansas, Missouri, Louisiana and Tennessee

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FIVE BASIC STEPS BEFORE PLANTING

Soil temperature is a key in timing cotton planting operations. The FIVE BASIC STEPS listed below give a practical approach to the problem of "When to Plant".

1. Study the soil temperature probability tables on pages 8, 9, 10. See when favorable temperatures normally occur in your area.
2. Keep well informed on current weather conditions and soil temperature trends. Daily advisories are issued by the U. S. Weather Bureau Agricultural Weather Service. Radio and television stations and newspapers distribute the advisories through the Mid-South.
3. Give particular attention to the long range forecasts and agricultural weather advisories which cover periods up to two weeks.
4. When conditions approach favorable limits, make frequent soil temperature reading over your entire fields. For seed of **average quality,** the **average** soil temperature at the 2-inch level should be about 68°F.
    - a. An early morning minimum temperature of 60°F is equivalent to the 68°F average
    - b. A 10 a.m. reading of 68°F on a clear day is equivalent to the 68°F average.
5. Remember, soil temperature should average 68°F or higher during germination and emergence. This means **69°F or higher for about 10 days after you** plant, not just on the day that you plant.

If these soil temperature factors, as well as soil moisture conditions, appear favorable, you will minimize these planting risks and your chances for success will be increased.

ACKNOWLEDGEMENTS

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SOIL TEMPERATURES AND COTTON PLANTING IN THE MID-SOUTH

By J. A. RILEY, D. H. NEWTON, J. W. MEASELLS, D. A. DOWNEY and LEONARD HAND[1]

Competition in the fiber market today demands that cotton growers produce a high quality crop at a minimum cost. Planting is the first pivot point in the series of production decisions. Modern cotton planters cannot afford the luxury of frequent replanting.

Pre-emergence weed control practices, along with the cost of the planting operation, make replanting expensive. The supply of high quality seed is limited and the farmer may have to use a lower quality if he replants. Today's mechanical equipment can plant a field in a relatively short time. These factors make it economically practical for the planter to wait until he has a good chance to obtain a satisfactory stand at the first planting.

Getting a stand of cotton depends on many different variables, but the primary weather elements are moisture and temperature. It is relatively easy to see if the soil is too wet or too dry. However, it is not easy to see if it is too cold.

We know that cottonseed will develop properly at a temperature of 68° F or higher. But we also know that soil temperature is a variable thing. It varies according to geographical location, time of year, time of day, depth below the surface, and soil characteristics. We need to know what effect the **maximum, minimum,** and **average** soil temperatures have on cottonseed development.

Extensive soil temperature measurements have been made in the field by the U. S. Weather Bureau, the Mid-South State Agricultural Experiment Stations, and the U. S. Department of Agriculture. The purpose of this bulletin is to help the Mid-South cotton planter use available soil temperature information to decide when to plant his crop.

Soil Temperature and Seedling Development

Laboratory tests have defined three temperature thresholds for cottonseed germination and seedling growth. The minimum temperature is near 60° F, the maximum is about 102° F and the optimum is in the 85° F to 95° F bracket. Research at the Delta Branch of the Mississippi Agricultural Experiment Station showed that emergence averaged 93 percent with a soil temperature of 70° F, about 75 percent with 65° F, and around 10 percent with 60° F.

Seed quality is a **major** factor in the way soil temperature effects seed development. High quality seed was used in the experiment which gave 75 percent emergence with 65° F average soil temperature. With seed of average quality, the soil temperature should be around 68° F. For a good rate of emergence with low quality seed, the soil temperature should average 70° F or higher.

Low temperatures have a direct detrimental effect on cotton seedlings. This varies from lethal in the case of freezing temperatures to a condition that merely slows growth in less extreme cool weather.

Freeze damage is rare, but when it does occur, the farmer has no choice; he must replant. Injury resulting from low temperatures that are above freezing is called chilling damage. This occurs much more frequently than freeze damage, and since it usually does not kill all of the seedlings, the farmer must decide whether to replant or not.

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[1] Agricultural meteorologists, Weather Bureau, U. S. Department of Commerce.

Dr. M. N. Christiansen of the Delta Branch Experiment Station has found two distinctly different types of chilling damage resulting from different sequences of cold weather. In one test, the temperature of germinating seed was held in the 40° F to 50° F range for six days and then raised to 86° F. Here, the tip of the primary root was destroyed but many lateral roots sprouted to help take its place. Seedling development showed a definite time lag compared with growth under favorable temperatures.

In the other test, the temperature was held at 86° F for one day, dropped to 40°F to 50° F for six days, and then raised back to 86° F. Here, the outside layers of the primary root were destroyed. Seedling development was drastically reduced as compared with growth under favorable temperatures. Disease resistance of seedlings with this injury was also greatly reduced.

Planters should seek to avoid either type of chilling damage, but of the two, the greatest injury results when the seedlings have been subjected to a short period of favorable temperature before the onset of low temperature.

The optimum soil temperature for cottonseed germination is between 85° F and 95° F. Obviously the Mid-South farmer cannot wait for this. Cotton planted late in the season is more vulnerable to some insects, early summer dry spells, early fall rains, and early winter freezes. The farmer must balance the chance of being caught by low soil temperatures against the chance of waiting too long. Timing is the key factor in planting cotton.

Soil temperatures have very large seasonal variations. The temperature at the 2-inch level normally reaches the upper 60s by the middle of April in the Louisiana Delta and by the last of April in the Missouri Bootheel. You notice we say "normally" but "normal weather" does not always occur. Large cold air masses from Canada occasionally drift this far south as late as May. When they are preceded by clouds that block the sunshine and surface moisture that cools the ground by evaporation, soil temperatures tumble.

A late cold spring is one of the greatest weather worries of the Mid-South planter. Weather records of 1960 illustrate this point. During the period May 11-13, soil temperatures dropped into the high 40s in the Missouri Bootheel, extreme northeast Arkansas and northwest Tennessee, and into the low 50s as far south as the Mississippi and Louisiana Delta areas. About one-third of the Mississippi Delta crop had to be replanted. A conservative estimate would score this at well over a million dollar loss in this one area.

Why Soil Temperatures Vary

Radiant heat from the sun is the main source of energy that warms the soil. Radiant heat from the ground and evaporation of moisture from the ground are the two main features that carry away heat from the soil. Basically, soil temperature is a result of the balance between the incoming and outgoing heat energy.

When strong sunlight shines on cool soil, the soil warms rapidly. In areas of no rain and little cloudiness, soil temperatures follow a regular pattern. In the Mid-South, rainfall and cloudiness are frequent but variable and thus soil temperatures do not follow a regular pattern.

During the spring, the sun rises a little higher in the sky each day. If there were no clouds, a little more heat would be received each day. Cloudiness normally decreases from March through May in the Mid-South. The dual effect of the altitude of the sun and the amount of cloudiness give twice as much heat from

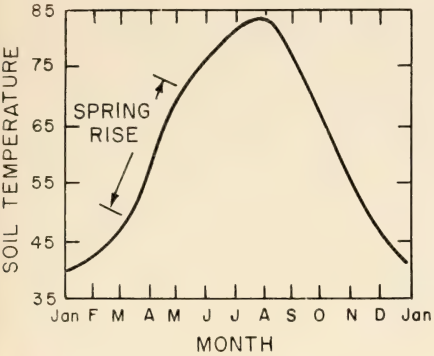

Figure 1—Average monthly 4-inch soil temperature near Northeast Arkansas Experiment Station, Keiser, Arkansas.

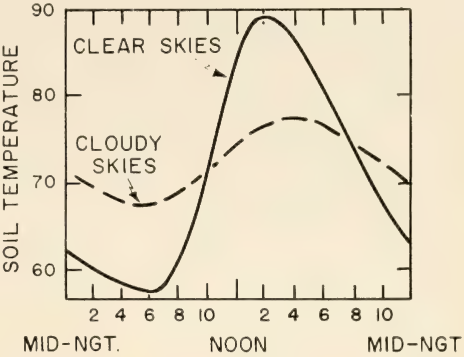

Figure 2—Hourly 4-inch soil temperature in May near Keiser, Arkansas with clear skies and cloudy skies.

the sun in late May as in early March.

Figure 1 shows the month-to-month variation of average soil temperature at the 4-inch depth near the Northeast Arkansas Experiment Station at Keiser. Springtime is a period of rapid rise, and it is easy to see how an extensive period of cloudy wet weather can temporarily delay the normal rise of soil temperature.

The spring temperature rise shown in Figure 1 means that the soil acts as a storehouse of heat. Clouds keep much of the sun's heat from ever reaching the ground. Also much of the heat that does reach the ground is given off by radiation and used up by evaporation and plant growth.

Surprisingly, much of the heat is stored in the ground during the rising part of the seasonal soil temperature cycle and given off during the cooling part. About 5000 calories of heat are stored under each square centimeter of soil each spring and summer. To make this a more practical figure, the heat stored by each acre of soil is equivalent to that available from 8000 gallons of gasoline. If you could utilize the heat stored under each acre of ground, you could use it to drive your pickup truck about 100,000 miles.

On a smaller scale, we have the same rising and falling soil temperature cycle each day. Figure 2 shows the hour-to-hour variation during the spring at the Northeast Arkansas Experiment Station. The solid line shows the changes under clear skies. The dashed line shows the much smaller changes that occur with cloudy skies.

In the spring, the temperature at seed depth averages 18° F higher in the afternoon than in the early morning. To use the soil temperature correctly in your planting schedule, you must take into account this daily cycle. Three different soil temperature measurements have been used in planting recommendations: **Maximum, Minimum** and **Average.** Each measurement is related to the rate of cottonseed development, but each relationship is different.

Figure 3 indicates how the three different readings are related to seedling development. For example, let us say the soil temperature is 70° F and all other conditions are favorable for planting. If the **minimum** temperature (bottom curve) is 70° F, emergence requires the least amount of time, somewhere around 4 days. If the **average** temperature is 70° F, the time required for emergence is about one week. If the **maximum** temperature is 70° F, the time required for emergence is the greatest, probably 10 days or so.

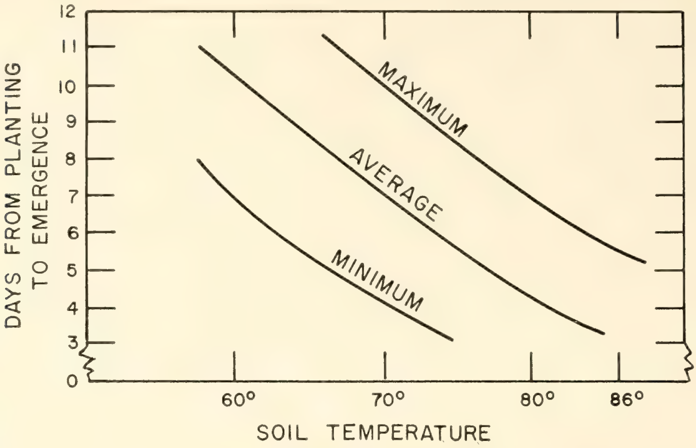

Figure 3—Relation of maximum, minimum and average soil temperature to the number of days required from planting to emergence.

The average temperature is based on two readings, both the maximum and minimum. For this reason, we think it is a more useful measurement for a planting schedule than either the maximum or minimum readings.

When measuring soil temperatures in your own fields, remember that the time of day strongly influences the reading. As shown is Figure 2, the 10 a.m. reading is close to the average between the maximum and minimum. When listening to soil temperature reports on the radio and television, use the **average** soil temperature for planting. If you use the maximum or minimum, you should make adjustments by fitting the reading into the daily pattern shown on Figure 2.

Soil temperatures also vary according to the depth below the surface. Soil conducts heat rather slowly, thus a difference in extreme values is smaller in the lower levels. Also maximum and minimum temperatures occur later at the lower levels. This time lag applies to both seasonal and daily changes.

Figure 4 shows monthly readings at several depths at the Southeast Experiment Station, Sikeston, Missouri. Summer temperatures at the one-inch level are much higher than at the 6-foot level. Winter temperatures near the surface are correspondingly cooler than deeper levels. Average temperatures at shallow levels rise faster than in greater depths. The 68° F average temperature mentioned as a desirable planting temperature refers to the 2-inch level.

When measuring soil temperatures in your own fields, check to see if the soil is unusually cold 6 to 10 inches below the surface. If it is cold, heat will have to be carried down from seed level to warm lower depths.

The average monthly soil temperature at the 2-inch depth is similar to the average monthly air temperature. On a day-to-day basis, however, there are important exceptions.

Figure 5 shows the daily averages of soil and air temperatures at the Northeast Louisiana Experiment Station in Saint Joseph for April 7-19, 1963. The average soil temperature is 7° F higher than the average air temperature on April 13-14. North winds on these two days carried cold air over Saint Joseph. To a lesser extent, the same thing happened April 7-8. On April 10-11 and April 17-18, the reverse was true. Southerly winds raised

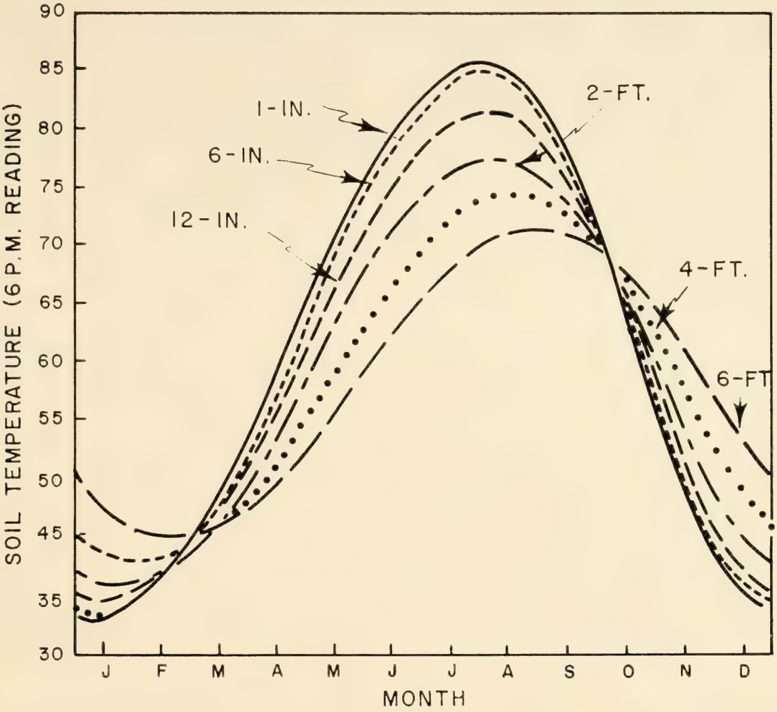

Figure 4—Soil temperatures near the Southeast Missouri Experiment Station, Sikeston, Missouri. 1951-1963, 6 p.m. readings.

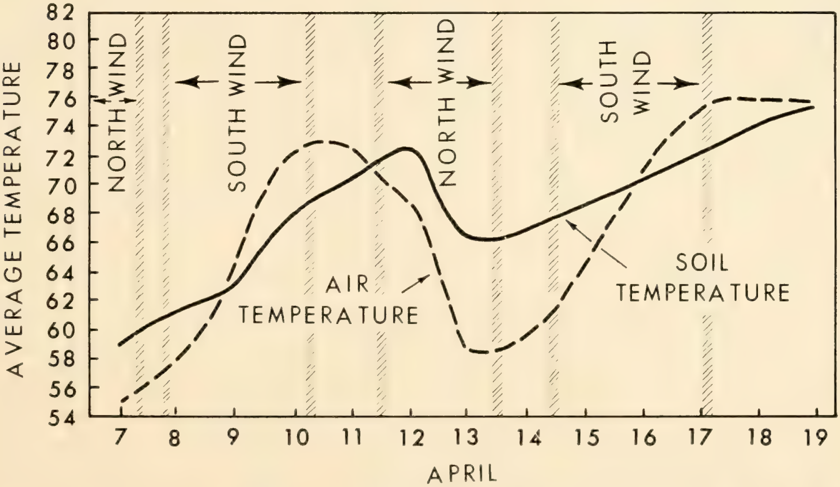

Figure 5.—Average daily 2-inch soil temperature and air temperature at the Northeast Louisiana Experiment Station, Saint Joseph, Louisiana, April 7-19, 1963. North winds give lower air temperature; south winds give higher air temperatures.

the air temperature above the soil temperature.

From this, we can see that a warm day does not necessarily indicate a warm soil and a cool day does not always indicate a cool soil.

In addition to the variations of time and depth mentioned above, other factors cause soil temperatures to vary from spot to spot in the same field at the same time. The type of soil, the slope of its surface and its moisture content all cause spot-to-spot variation.

If the temperature of the soil is increased one degree, it has been proven that more heat is generally required to raise the temperature of a clay soil than a sandy soil. This is also true if the soil is saturated with water, but in this case wet sandy soil requires nearly twice as much heat as dry sandy soil and wet clay about three and one-half times as much heat as dry clay. Also, water does not drain through clay as fast as sand and the heat used in evaporating the moisture cools the clay.

Color also affects temperature; dark soils absorb more heat than light colored soils. Since most Mid-South clay soils are dark colored, some clay soils become warmer than sandy soils especially in dry weather. Because of these different heating characteristics of different soils, you should measure the soil temperature in many parts of your field to be sure that you are getting a representative reading.

Probable Soil Temperature at Planting Time

Long-term weather records show that soil temperatures rise during the spring from March through May. The rise during any individual spring is usually irregular. A steady rise is very unusual. But if we average the observations over a period of years, we will see a steady rise.

For a good rate of seed development, we want the 2-inch soil temperature to average 68° F or higher for 10 days after planting date. Over a period of years, this happens in the southern Louisiana Delta by April 11 and in the Missouri Bootheel by April 26. The map on the front of the bulletin divides the Mississippi Delta cotton growing area into six zones. The critical soil temperature level occurs three days later in each zone as you move northward from Zone A.

The middle column of Table 1 shows the probable dates that the 2-inch soil temperature will begin to average 68° F for 10 days after planting date. These "average" dates give the planter some helpful information. But to use weather records for the most efficient planting schedule, the planter must also understand the chance of having "unaverage" conditions.

To plant well on the safe side, we look at the third column under the heading "Three Years in Four." In Zone A, the southern Louisiana Delta, three out

Table 1.—**Probability that the 2-inch soil temperature will average 68°F for 10 days after planting date in the six cotton growing areas of the Mid-South shown on the front page.**

	Probability		
Zone	One Year in Four	Two Years in Four	Three Years in Four
A	April 2	April 11	April 18
B	April 5	April 14	April 21
C	April 8	April 17	April 24
D	April 11	April 20	April 27
E	April 14	April 23	April 30
F	April 17	April 26	May 3

Table 2.—Probability that the daily minimum soil temperature (2-inch level) will go below 60°F, 55°F or 50°F on at least one day during the 10-day period following planting date in Zone C.[1]

Planting Date	Probability of at least one day below 60°F	55°F	50°F
March 20	100	100	90
March 31	100	95+	80
April 10	95+	80	50
April 20	80	50	10
April 30	50	10	5—
May 10	20	5—	5—

[1] Add 3 days for each zone to the north and subtract 3 days for each zone to the south.

of four springs, will maintain the 68° F average by April 18. In Zone F, the Missouri Bootheel, three out of four springs, will maintain the 68° F average by May 3. When these dates are used, first plantings should produce good stands three out of four years.

The first column shows the risk of early planting. If you plan to plant in the southern Louisiana Delta on April 2, there is only one out of four chances that the soil temperature fill hold a 68° F average. Is the northern zone, there is only a one out of four chance that the soil temperature will hold the 68° F average on April 17.

Soil temperatures can average 68° F or higher for a 10-day period but still include a few cold days. Table 2 shows the probability that the minimum temperature will drop below 60° F, 55° F or 50° F on at least one day during the 10-day period in Zone C. Growth is slow when the minimum temperature drops below 55° F and chilling damage occurs when it dips below 50° F.

Using Table 2, we can see the hazard of early planting quite plainly. For example, if the Zone C planter does plant on March 31, he can be sure that one day during the next 10 will drop below 60° F and almost as certain that one day will go below 55° F. On 8 out of 10 years, there will be at least one day with below 50° F and thus some chilling damage will result.

On April 10, there is a 50-50 chance of having one day below 50° F during the next 10 days. On April 20, there is a 50-50 chance of having one day below 55° F, and as late as April 30, there is a 50-50 chance of having one day below 60° F. By April 20, there is only one chance in 10 of having a temperature of 50° F or lower.

Table 2 is based on soil temperature observations at the Delta Branch of the Mississippi Experiment Station in Stoneville and represents Zone C. If you add 3 days for each zone to the north, or subtract 3 days for each zone to the south, you can apply this information to all zones. For a practical planting schedule, this information conforms with Table 1, which indicates only a small probability of chilling damage after: April 18 in Zone A, April 21 in Zone B, April 24 in Zone C, April 27 in Zone D, April 30 in Zone E, and May 3 in Zone F.

Bed Shape and Soil Temperature

So far we have discussed how soil temperatures vary with time and with depth, but all of this applies to flat lands. The flat bed, or the broadcast type of land preparation, is increasing in popularity in dry areas, but in the rain belt, most farmers still use a bed of medium height. The medium bed elevates the seed and reduces water-logging damage and at the same time it increases soil temperatures.

The surface area of a flat one acre field is exactly one acre. The surface area of a bedded-up one acre field amounts to about one and one-fourth acres. Because of the additional surface

Table 3.—Two-inch soil temperatures in the row and on the flat at the West Tennessee Experiment Station, Jackson, Tennessee, April 3-May 12, 1963.

	Maximum		Minimum		Average	
Date	Flat	Row	Flat	Row	Flat	Row
April 3-12	71.8	74.5	54.5	53.4	63.2	64.0
April 13-22	75.6	78.8	57.7	56.8	66.7	67.8
April 23-May 2	70.5	71.8	56.5	55.0	63.5	63.4
May 3-12	83.1	85.8	62.6	61.7	72.9	73.8
Average	75.3	77.6	57.8	56.7	66.6	67.2

area, the bedded field is more exposed to sunlight in the daytime and radiates more heat at night.

When the sun shines directly on a surface, reflection is at a minimum. In a bedded field, part of the bed surface is at right angles to the sun most of the time. This increases the amount of heat absorbed by the surface and transmitted to the seed and root level. Also, wind hits a larger area and evaporation is greater in the bedded field, thus the soil dries faster. All this adds up to higher daytime temperatures and lower nighttime temperatures in the row than on the flat.

Table 1 summarizes 2-inch soil temperature observations at the West Tennessee Experiment Station, Jackson, Tennessee during the planting season. In the row, the maximum is higher than in flat ground. The reverse is true for the minimum. The average between the maximum and minimum shows that the row is slightly warmer, about one degree.

Although the average temperature in the row is slightly higher than in the flat bed, we must look at another measure to evaluate the temperature difference and its effect on seed germination. Little growth is made below 65° F, and so if we compare the difference in temperatures above this level, we will have a more practical measure of temperatures that affect growth.

The degree hour is sometimes used in such measurements. What is it? If the temperature at 9 a.m. is 66 degrees, we have one degree hour. If it is 67 degrees at 10 a.m., we have two degree hours. By adding the 9 a.m. and the 10 a.m. readings we have three degree hours. To calculate the total number of degree hours for a period, multiply the number of hours that the temperature was above 65 degrees by the number of degrees.

Table 4 shows the degree hour totals for the same periods shown is Table 3. During each 10-day period, the total shows more degree hours in the bed than in the flat. The April 23 — May 2 period was cool and rainy and the degree hour total was small. Even so, the percentage differences in the last column show a steady decrease as the season advances. Thus, we can assume that bedding accumulates more degree hours around planting time than later in the season. The reasons for this is — minimum temperatures are warmer in the flat than in the bed. When minimum temperatures stop dropping below the 65-degree level,

Table 4.—Degree hour totals of 2-in soil temperatures in the row and on the flat at the West Tennessee Experiment Station, Jackson, Tennessee, April 3-May 12, 1963.

	Degree Hour		Percent
Date	Flat	Bed	Difference
April 3-12	64.8	83.8	22%
April 13-22	103.6	126.3	18%
April 23-May 2	59.4	67.5	12%
May 3-12	209.8	226.8	8%
Total	437.6	503.9	13%

differences in degree hour totals between the two types of planting areas become smaller.

The usual planting procedure calls for knocking off the top of the bed at planting time. This introduces still another source of soil temperature variation. When the top 6 inches of the bed are knocked off, the newly created 2-inch level has the 8-inch level soil temperature. In April the 8-inch level averages two to four degrees lower than the 2-inch level. In the field, however, this is not a large problem as the new 2-inch level assumes the temperature of its new environment within 24 to 48 hours.

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Mississippi Cotton Variety Tests, 1963

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Stoneville

Table 1.—Yield, gin turn out, boll size, staple length, strength, elongation, micronaire, and gross value per acre for the 1963 cotton variety test at Stoneville, Mississippi.

	Yield per acre			Number bolls per pound		Fiber Properties					Gross value
						Staple length					
Variety	Seed cotton	Lint	Percent lint	Seed cotton	Lint	Classer	UHM	Strength (T_1)	Elongation (E_1)	Micro-naire	per acre (SLM)
	lbs.	lbs.	pct.	no.	no.	inch	inch	index	index	index	dollars
Stoneville 213	3107	1143	36.8	66	177	1 3/32	1.19	1.94	7.0	4.76	432
DeKalb 220	2868	1047	36.5	52	143	1 3/32	1.16	1.89	6.7	4.60	396
Stoneville 7A	2879	1034	35.9	68	190	1 3/32	1.23	2.00	6.3	4.92	392
Fox 4	2953	1022	34.6	64	185	1 3/32	1.17	2.08	7.1	4.96	391
Carolina Queen	2837	1033	36.4	61	170	1 3/32	1.20	1.93	6.3	4.90	391
Stoneville 3202	2831	1028	36.3	66	181	1 1/16	1.11	1.72	7.6	4.44	386
DeKalb 108	2880	996	34.6	63	182	1 3/32	1.16	1.90	6.8	4.46	381
Delta Queen	2795	984	35.2	65	185	1 3/32	1.19	2.02	7.5	4.37	375
Stardel	2695	973	36.1	67	185	1 3/32	1.18	2.12	6.4	4.53	369
Deltapine Sm. Lf.	2634	964	36.6	64	178	1 3/32	1.17	2.09	8.4	4.65	364
Delfos 9169	2880	922	32.0	59	184	1 3/32	1.25	1.91	7.9	4.03	359
Auburn 56	2741	935	34.1	66	194	1 1/16	1.15	2.03	7.5	4.44	356
Dixie King	2637	918	34.8	52	150	1 3/32	1.17	2.02	5.8	4.65	351
M8	2507	908	36.2	67	185	1 3/32	1.16	1.98	8.3	4.26	344
Rex Smooth Leaf	2559	891	34.8	60	170	1 1/16	1.17	1.98	6.3	4.09	341
Coker 100A	2556	889	34.8	67	190	1 3/32	1.22	1.90	6.5	4.58	340
Auburn M	2577	886	34.4	67	195	1 1/16	1.14	1.97	7.4	4.23	337
Deltapine 15	2271	852	37.5	59	157	1 3/32	1.19	2.02	8.2	4.60	320
Empire WR 61	2385	816	34.2	55	158	1 1/16	1.17	1.93	6.5	4.00	311
Average	2715	960	35.4								
LSD at 5% level		109									
CV		9.8%									

Planted April 22; harvested September 10 and October 9. Soil: Deer Creek sandy loam.

Mississippi Cotton Variety Tests For 1963

IN THE DELTA

By JAMES B. DICK and ROBERT H. LOE[1]

Cotton variety trials were conducted by the Delta Branch Experiment Station in 1963 in the Yazoo-Mississippi Delta at four locations; the Delta Station at Stoneville, the Woolfolk Plantation near Tunica, the Heaton Plantation at Clarksdale, and the Schaefer Plantation near Yazoo City.

The 1963 season was one of the most favorable for cotton production ever experienced in the Delta. Early plantings gave good stands, with very little seedling disease. Although rain was excessive in some locations during July, the favorable weather of August and early September was conducive to heavy production of fruit and to maturity of bolls. Boll rot was negligible in most fields.

Environmental conditions during September, October and November were very favorable, and a large proportion of the Delta crop was harvested rapidly. Cotton yields throughout Mississippi were very high. In the Delta many plantations averaged over two bales of cotton per acre. Quality of the 1963 Delta cotton crop was excellent. The high grades, good staple length, micronaire and fiber strength of Delta cotton have caused this high quality product to be in heavy demand by the textile mills.

Current strains of 17 commercial varieties were grown in the 1963 variety trials. In addition Carolina Queen, a new variety, was grown in the Stoneville test. The Stoneville and Tunica trials are included in a belt wide variety testing program.

Table 1 gives the results of the yield trial at the Delta Station. The test was planted on April 22. Favorable weather prevailed throughout the season, with 8 inches of rain during the first half of July followed by a prolonged dry period. The first picking was made on September 10, at which time 75% of the entire yield was harvested. Yields ranged from 1143 to 816 pounds of lint per acre, with an overall average of 960 pounds. Lint percentages were lower than usual. Tensile strengths and staple lengths were better than average for the varieties grown.

Table 2 gives results of the Tunica yield trial. The test plots were planted on May 7. Good stands were obtained. Rain during early September delayed maturity and a first harvest could not be made until October 8. Final harvest was made on November 7. Yields ranged from 1229 to 801 pounds of lint per acre, with an overall average of 1022 pounds. Lint percentages were about normal in this test. Staple lengths were approximately 1/32 inch longer than in 1962, and the micronaire indexes indicated a fine fiber in most of the varieties.

Table 3 gives results of the Clarksdale test. Good stands were obtained from replanting on May 7. Yields in this test were below the plantation yields in nearby areas. This may have been caused by compaction resulting from tractor work done on damp soil in preparing the land for replanting. Other factors probably influenced the yield, which averaged 662 pounds of lint per acre. Lint percents and micronaire indexes were low for all varieties; staple length and fiber strength were better than normal.

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[1] Research Agronomist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Assistant Agronomist, Delta Branch Experiment Station, Mississippi Agricultural Experiment Station. This report is based upon results from cooperative research conducted by the Mississippi Agricultural Experiment Station and Crops Research Division. Agricultural Research Service, U. S. Department of Agriculture.

Tunica

Table 2.—Yield, gin turn out, staple length, strength, elongation, micronaire, and gross value per acre for the 1963 cotton variety test at Tunica, Mississippi.

	Yield per acre			Fiber Properties					Gross value per acre
				Staple length					
Variety	Seed cotton	Lint	Percent lint	Classer	UHM	Strength (T_1)	Elongation (E_1)	Micronaire	(SLM)
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 213	3144	1229	39.1	1 3/32	1.11	1.95	7.2	4.48	454
Delta Queen	3179	1170	36.8	1 3/32	1.17	2.01	8.2	4.19	442
Coker 100A	2970	1123	37.8	1 3/32	1.15	1.91	7.0	4.64	422
Delta Sm. Lf.	2893	1085	37.5	1 3/32	1.14	1.90	8.0	4.34	408
Delfos 9169	3081	1063	34.5	1 3/32	1.16	1.89	7.6	4.04	407
DeKalb 220	2899	1047	36.1	1 1/16	1.14	1.84	7.1	3.82	394
Auburn 56	2932	1035	35.3	1 1/16	1.07	1.98	7.9	4.00	391
Stoneville 3202	2711	1027	37.9	1 1/16	1.06	1.73	7.3	3.80	382
DeKalb 108	2847	1008	35.4	1 1/16	1.13	2.01	7.5	4.18	381
Auburn M	2768	988	35.7	1 1/16	1.12	1.92	7.5	4.14	373
Stardel	2608	983	37.7	1 1/16	1.13	1.95	6.9	4.48	366
Fox 4	2730	964	35.3	1 1/32	1.18	1.90	8.1	4.44	364
Deltapine 15	2523	971	38.5	1 3/32	1.15	2.03	8.0	4.09	363
Dixie King	2621	954	36.4	1 3/32	1.11	1.90	7.3	4.06	358
Stoneville 7A	2469	958	38.8	1 1/16	1.14	1.95	7.0	4.54	355
Rex Sm. Lf.	2374	845	35.6	1 1/16	1.15	1.93	7.5	3.80	319
Empire WR 61	2349	801	34.1	1 1/16	1.09	1.86	6.8	3.85	305
Average	2785	1022	36.7						
LSD at 5% level		163							
CV		11.3%							

Planted May 7; harvested October 8 and November 7. Soil: Sandy loam.

Clarksdale

Table 3.—Yield, gin turn out, staple length, strength, elongation, micronaire, and gross value per acre for the 1963 cotton variety test at Clarksdale, Mississippi.

	Yield per acre			Fiber Properties					Gross value per acre
				Staple length					
Variety	Seed cotton	Lint	Percent lint	Classer	UHM	Strength (T_1)	Elongation (E_1)	Micronaire	(SLM)
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 7A	2022	758	37.5	1 1/16	1.12	1.87	6.4	4.37	283
Stoneville 213	2009	745	37.1	1 3/32	1.13	1.81	7.4	4.47	281
Deltapine Sm. Lf.	2025	739	36.5	1 3/32	1.12	2.00	8.5	4.01	279
Deltapine 15	1963	722	36.8	1 1/16	1.12	2.02	8.5	3.93	270
Auburn 56	2082	689	33.1	1 3/32	1.12	1.97	7.7	3.79	266
Stardel	1878	685	36.5	1 3/32	1.11	1.87	6.9	4.19	259
DeKalb 220	1960	682	34.8	1 1/16	1.12	1.95	7.0	3.79	259
Fox 4	1927	661	34.3	1 3/32	1.13	1.94	7.2	4.04	253
DeKalb 108	1963	654	33.3	1 3/32	1.15	1.87	7.5	3.72	252
Dixie King	1897	656	34.6	1 1/16	1.11	1.85	6.8	3.91	249
Auburn M	1884	639	33.9	1 3/32	1.10	1.99	7.4	3.60	246
Coker 100A	1794	633	35.3	1 3/32	1.14	1.96	6.9	4.14	241
Delta Queen	1837	623	33.9	1 3/32	1.16	1.98	7.2	3.94	240
Stoneville 3202	1739	624	35.9	1 1/16	1.03	1.77	7.2	4.09	235
Empire WR 61	1748	601	34.4	1 3/32	1.10	1.87	6.8	3.89	230
Rex Sm. Lf.	1764	593	33.6	1 3/32	1.11	1.88	7.0	3.71	228
Delfos 9169	1761	558	31.7	1 1/8	1.17	1.91	8.3	3.69	220
Average	1897	662	34.9						
LSD at 5% level		93				CV			9.7%

Planted May 7; harvested September 19 and October 30. Soil: Sandy loam.

Yazoo City

Table 4.—Yield, gin turn out, staple length, strength, elongation, micronaire, and gross value per acre for the 1963 cotton variety test at Yazoo City, Mississippi.

	Yield per acre			Fiber Properties					Gross value per acre (SLM)
Variety	Seed cotton	Lint	Percent lint	Staple length Classer	Staple length UHM	Strength (T_1)	Elongation (E_1)	Micronaire	
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 7A	2831	1113	39.3	1 3/32	1.12	1.94	7.3	4.77	414
Stoneville 213	2831	1101	38.9	1 3/32	1.11	1.95	8.3	4.30	411
Delta Queen	2942	1083	36.8	1 3/32	1.12	2.00	8.0	4.07	409
DeKalb 220	2823	1042	36.9	1 3/32	1.12	1.88	7.3	4.18	393
Delfos 9169	2948	1029	34.9	1 3/32	1.13	1.86	7.9	4.00	393
Stoneville 3202	2774	1057	38.1	1 1/16	1.02	1.71	8.0	3.93	393
Deltapine Sm. Lf.	2684	1039	38.7	1 3/32	1.10	1.94	8.7	4.40	388
Auburn 56	2885	1013	35.1	1 3/32	1.08	1.83	8.0	4.02	386
DeKalb 108	2638	963	36.5	1 1/16	1.12	1.82	7.8	4.15	361
Dixie King	2605	956	36.7	1 3/32	1.08	1.83	6.7	4.25	361
Coker 100A	2600	944	36.3	1 3/32	1.12	1.97	7.7	4.26	357
Stardel	2463	948	38.5	1 1/16	1.10	2.04	7.0	4.13	352
Auburn M	2559	914	35.7	1 3/32	1.11	1.80	8.0	3.93	347
Rex Sm. Lf.	2461	918	37.3	1 3/32	1.10	1.84	7.3	3.84	346
Empire WR 61	2431	904	37.2	1 3/32	1.02	1.83	7.0	3.97	341
Fox 4	2455	906	36.9	1 1/16	1.06	1.96	8.0	4.20	339
Deltapine 15	2322	896	38.6	1 3/32	1.11	2.03	8.1	4.00	335
Average	2655	989	37.3						
LSD at 5% level		128							
CV		9.1%							

Planted April 17; harvested September 4 and October 22. Soil: Sandy loam.

Delta Average

Table 5.—Average lint percent, classer's staple length, upper half mean, fiber strength, and micronaire for 17 varieties grown at four Delta locations in 1963.

Variety	Lint percent	Classer's staple length	Upper half mean	Fiber Strength (T_1)	Micronaire
	pct.	inch	inch	index	index
Auburn M	34.9	1 1/16+	1.12	1.92	3.98
Auburn 56	34.4	1 1/16+	1.11	1.95	4.06
Coker 100A	36.1	1 3/32	1.16	1.94	4.41
Delfos 9169	33.3	1 3/32+	1.18	1.89	3.94
Deltapine 15	37.9	1 3/32	1.14	2.03	4.16
Deltapine Smooth Leaf	37.3	1 3/32	1.13	1.98	4.35
Delta Queen	35.7	1 3/32	1.16	2.00	4.14
DeKalb 108	35.0	1 1/16+	1.14	1.90	4.13
DeKalb 220	36.1	1 1/16+	1.14	1.89	4.10
Dixie King	35.6	1 1/16+	1.12	1.90	4.22
Empire WR 61	35.0	1 1/16+	1.11	1.87	3.93
Fox 4	35.3	1 3/32	1.13	1.97	4.41
Rex Smooth Leaf	35.3	1 1/16+	1.13	1.91	3.86
Stardel	37.2	1 1/16+	1.13	2.00	4.33
Stoneville 7A	37.9	1 1/16+	1.15	1.94	4.65
Stoneville 213	38.0	1 3/32	1.14	1.91	4.50
Stoneville 3202	37.1	1 1/16	1.06	1.73	4.07

Data from the test conducted near Yazoo City are given in Table 4. Dry weather in June was followed by 17 inches of rainfall in July. No rainfall occurred in August, September or October. Yields ranged from 1113 to 896 pounds of lint per acre with an overall average of 989 pounds. Staple lengths were approximately 1/32 inch longer than normal. Lint percents and fiber strengths were about normal for the varieties planted. Micronaire indexes indicated finer fibers than normal.

Yields of seed cotton and lint, lint percentages, fiber properties, and gross money value per acre are given in Tables 1 through 4 for the four variety-yield trials. Money value was computed by adding the Commodity Credit Corporation loan value for the staple length of each variety at Strict Low middling grade and the seed value at $60.00 per ton. Varieties are ranked in each table in order of dollar value per acre.

Table 5 shows the average lint percentages, staple lengths, fiber strengths, and micronaire indexes for each of the 17 varieties for the four tests. Earliness data was not obtained. Lint percentages are highest for Stoneville 213, Stoneville 7A. Deltapine 15, and Deltapine Smooth Leaf, and lowest for Delfos 9169, Auburn 56, and Auburn M. All varieties have staple lengths of 1-1/16 to 1-3/32 inches. Delfos 9169 has an upper half mean length of 1.18 inches, and Stoneville 3202 an upper half mean length of 1.06 inches. The other varieties are intermediate in staple length. Fiber strength, or tenacity (T_1), as determined by the stelometer at 1/8 inch gauge length, is relative. By this measure Deltapine 15, Delta Queen, Stardel, Deltapine Smooth Leaf, and Stoneville 7A have the stronger fibers. Fineness, as measured by the micronaire, ranged from 3.86 for Rex Smooth Leaf and 3.94 for Empire to the coarser fibered Stoneville 7A, Stoneville 213, Fox 4 and Coker 100A. All the varieties have micronaire values well within the range (3.5 to 5.0) desired by most textile mills.

Yield data were taken from solid plantings of replicated and randomized 2-row plots in each test. Statistical analysis of these data indicated that the four tests were very precise. Other data were determined from samples taken at first harvestings. Classing was done by the Staple Cotton Cooperative Association in Greenwood, Mississippi. Fiber properties data were determined by the fiber laboratory of the Crops Research Dvision, Agricultural Research Service, U. S. Department of Agriculture, at Knoxville, Tennessee.

COTTON TESTS IN HILL SECTIONS

By G. D. GREEN, R. C. ALBRITTON, R. E. COATS, S. P. CROCKETT, B. C. HURT, JR., B. E. WAGGONER, AND L. B. WALTON

Nineteen commercial varieties were entered in each of nine tests in the hill section of Mississippi in 1963. Yields indicate that conditions were favorable for cotton at most locations even though a considerable portion of the growing season was on the dry side, especially from State College southward.

Each of the 19 varieties produced at the rate of two bales or more per acre in at least one test and 11 of them in two or more tests. The average yield in all tests was 845 pounds of lint per acre. The test at the Brown Loam Branch Station, Raymond averaged 1112 pounds and the one at the Black Belt Branch Station, Brooksville 1082 pounds.

Five new entries common to all the tests were included for the first time. Rex Smooth Leaf and Deltapine 45 are

Summary Tables

Summary Table showing average yields of cotton varieties which have been in Hill Station tests for five or more years, in pounds of lint per acre for years indicated.

Variety	State College 59-63	Brooksville 59-63	Newton 60-61 & 63	Raymond 60 & 62-63	Pontotoc F'woods 59-63	Pontotoc Ridge 59-63	Holly Springs Hill 59-63	Holly Springs Bottom 61-63	Verona 59 & 62-63	Average
Stoneville 3202	686	852	634	750	634	786	767	972	926	779
Auburn 56	728	795	670	756	647	808	813	954	817	776
Coker 100A WR.	713	816	633	630	633	823	765	969	800	754
Dixie King	714	801	622	667	655	787	740	856	838	742
Deltapine Sm. Lf.	681	852	614	764	601	736	706	888	809	739
Fox 4	666	792	596	665	586	767	698	822	822	713
Delfos 9169	695	759	542	675	548	657	720	858	768	691
Deltapine 15	627	782	563	685	509	697	650	794	777	676

Summary Table showing average yields in Hill Station cotton variety tests in 1963, in pounds of lint per acre.

Variety	State College	Brooksville	Newton	Raymond	Pontotoc F'woods	Pontotoc Ridge	Holly Springs Hill	Holly Springs Bottom	Verona	Average
Stoneville 213	740	1227	955	1373	777	919	788	1087	499	929
Carolina Queen	807	1174	1038	1133	789	1056	797	1067	430	921
DeKalb 220	847	1132	977	1182	799	888	804	1012	554	911
Stoneville 3202	687	1136	927	1150	697	988	745	924	596	872
Delta Queen	738	1176	942	1108	752	907	772	989	465	872
Auburn 56	801	967	970	1144	710	939	779	939	551	867
Stoneville 7A	722	1185	866	1014	693	894	820	1009	587	866
Auburn M	836	841	965	1056	752	1039	845	918	403	851
Empire WR. 61	711	957	911	1477	727	854	661	832	489	847
Coker 124B	734	1106	945	1058	709	892	774	959	442	847
Deltapine Sm. Lf.	676	1238	878	1175	668	843	685	951	489	845
Dixie King	806	1094	884	1053	787	944	705	833	439	838
DeKalb 108	727	967	858	1143	695	939	800	913	453	833
Coker 100A WR.	713	1074	955	888	691	991	750	990	434	832
Rex Smooth Leaf	786	845	967	1052	718	949	797	857	389	818
Deltapine 45	574	1166	710	1120	719	913	651	920	503	808
Fox 4	630	1122	845	955	646	824	626	896	505	783
Deltapine 15	610	1152	817	945	573	831	679	824	460	766
Delfos 9169	611	997	759	1109	597	784	692	892	368	757

State College

Cotton Variety Averages, Central Station, State College.

	Yield per acre, pounds lint						Averages			
							Val. per a./SLM,	Lint	Staple, 32nds.	Bolls per lb
Variety	1959	1960	1961	1962	1963	Average	dollars	percent	inch	lint
Auburn 56	700	713	561	866	801	728	261	36.2	34.4	186
Dixie King	688	756	490	830	806	714	256	37.7	34.5	146
Coker 100A, WR.	755	748	559	789	713	713	256	37.7	34.7	177
Delfos 9169	777	853	485	749	611	695	254	35.4	35.5	168
Stoneville 3202	684	741	562	754	687	686	243	38.2	33.8	186
Deltapine Sm. Lf.	635	772	499	824	676	681	243	38.6	34.9	190
Fox 4	634	700	535	829	630	666	239	37.2	34.4	188
Deltapine 15	612	675	512	727	610	627	223	39.6	34.5	183
DeKalb 108		748	576	826	727					
Delta Queen			547	893	738					
DeKalb 220			533	795	847					
Stoneville 7A			549	830	722					
Stoneville 213			502	839	740					
Carolina Queen				840	807					

Cotton Varieties, Central Station, State College, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound		Pct.
Variety	Seed cotton	lint	val. per A., slm	lint pct.	32 nds. inch	seed cotton	lint	first picking
DeKalb 220	2266	847	312	37.3	34.0	61	164	83
Auburn M	2247	836	309	37.2	34.0	63	171	89
Carolina Queen	2131	807	297	37.8	34.3	65	172	82
Dixie King	2167	806	298	37.2	34.0	56	151	85
Auburn 56	2216	801	293	36.1	33.7	67	185	90
Rex Smooth Leaf	2115	786	290	37.1	34.3	61	165	91
Stoneville 213	1995	740	269	37.1	33.3	71	193	84
Delta Queen	2080	738	275	35.4	34.7	66	187	84
Coker 124B	2001	734	273	36.6	35.0	65	179	83
Dekalb 108	2022	727	270	35.9	34.3	62	174	85
Stoneville 7A	2025	722	273	35.6	36.0	71	200	82
Coker 100A WR.	1926	713	263	37.0	34.0	65	177	80
Empire WR. 61	1977	711	264	35.9	34.7	54	152	88
Stoneville 3202	1921	687	252	35.7	33.3	70	196	86
Deltapine Sm. Lf	1887	676	248	35.8	33.7	75	210	78
Fox 4	1839	630	236	34.2	34.0	70	206	77
Delfos 9139	1776	611	226	34.3	33.7	58	170	84
Deltapine 15	1660	610	226	36.7	34.3	70	191	79
Deltapine 45	1568	574	209	36.6	33.7	71	195	72
LSD at 5%		89						
CV.		10.8%						

Planted April 22; poisoned 12 times; fertilized 72-48-48; soil, Verona fine sandy loam

new. Auburn M was new in 1962 and Empire WR 61 in 1961. Coker 124B is not new but has not been widely distributed in this area.

Of the 10 highest yielding varieties in the 1963 tests, only Stoneville 3202 and Auburn 56 have been in the tests as long as five years. Only eight of the total 19 entries have been in the tests as long as five years. See Summary Tables.

The highest yielding variety averaged 929 pounds of lint per acre and the lowest yielding one 757 pounds in the tests in 1963, a difference of 172 pounds. Of the eight varieties which have been in the tests as long as five years, the highest yielding one has averaged 779 pounds and the lowest one 676 pounds, a difference of 103 pounds.

These tests included one each at the Central Station, State College; Black Belt Branch Station, Brooksville; Coastal Plain Branch Station, Newton; Brown Loam Branch Station, Raymond; one on Flatwoods soil and one on Pontotoc Ridge soil at the Pontotoc Ridge-Flatwoods Branch Station, Pontotoc; one on hill land on the station and one on bottom land on the farm of Mr. C. C. Moore about 4½ miles north of Holly Springs by the personnel of the North Mississippi Branch Station, Holly Springs; and one on bottom land at the Northeast Mississippi Branch Station, Verona.

Stands were generally good. At the Brown Loam Branch Station, Raymond

Black Belt

Cotton Variety Averages, Black Belt Branch Station, Brooksville.

	Yield per acre, pounds lint						Averages			
							Val. per a./SLM,	Lint	Staple, 32nds.	Bolls per lb.
Variety	1959	1960	1961	1962	1963	Average	dollars	percent	inch	lint
Deltapine Sm. Lf.	778	590	600	1055	1238	852	303	40.5	34.4	212
Stoneville 3202	845	577	756	944	1136	852	299	39.7	33.3	213
Coker 100A, WR.	717	616	710	961	1074	816	293	38.5	34.6	204
Dixie King	835	610	606	859	1094	801	285	39.3	34.4	164
Auburn 56	817	582	709	902	967	795	284	37.5	33.9	211
Fox 4	728	590	630	888	1122	792	282	38.8	34.1	214
Deltapine 15	750	564	468	974	1152	782	278	40.5	34.5	215
Delfos 9169	693	615	585	905	997	759	278	35.9	35.5	200
DeKalb 108		630	799	900	967					
DeKalb 220			745	1008	1132					
Delta Queen			653	984	1176					
Stoneville 7A			588	1026	1185					
Stoneville 213				1002	1227					
Carolina Queen				999	1174					

Cotton Varieties, Black Belt Branch Station, Brooksville, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound		Pct.
Variety	Seed cotton	lint	val. per A., slm	lint pct.	32 nds. inch	seed cotton	lint	first picking
Deltapine Sm. Lf.	3099	1238	451	39.9	34.3	82	206	85
Stoneville 213	3030	1227	446	40.5	34.3	82	204	83
Stoneville 7A	2904	1185	430	40.8	34.3	76	187	80
Delta Queen	3067	1176	425	38.3	33.7	73	191	85
Carolina Queen	2953	1174	428	39.7	34.3	74	188	85
Deltapine 45	2862	1166	423	40.7	34.0	84	207	78
Deltapine 15	2880	1152	420	40.0	34.3	85	214	80
Stoneville 3202	2857	1136	414	39.7	34.3	82	208	89
DeKalb 220	2921	1132	414	38.7	34.0	72	185	82
Fox 4	2913	1122	412	38.5	34.0	84	220	82
Coker 124B	2882	1106	409	38.3	35.3	74	194	85
Dixie King	2531	1094	393	43.2	34.3	66	153	83
Coker 100A	2773	1074	393	38.7	34.3	76	198	85
Delfos 9169	2807	997	374	35.5	35.3	67	189	81
Dekalb 108	2572	967	356	37.6	34.7	69	185	85
Auburn 56	2588	967	357	37.3	34.0	77	206	87
Empire WR.61	2595	957	354	36.8	34.7	62	168	86
Rex Smooth Leaf	2283	845	312	37.0	34.7	69	186	88
Auburn M	2257	841	306	37.2	33.7	78	210	90
LSD at 5%		164						
CV.		10.0%						

Planted April 3; poisoned 6 times; fertilized 100-60-40; soil, Houston clay.

the test was replanted. Standard corrections were made for skips where necessary. Insects and weeds were not serious problems and were adequately controlled in all tests. Lint percentage, staple length and boll size were generally close to average for the variety and location. Some varieties varied more than others. Lint percentage was 1 to 2 percent lower than average in the Verona and both Pontotoc tests. Staple length was about 1/32 inch longer than average in the Holly Springs bottom land and the Pontotoc Flatwoods tests. Bolls were about 5 percent larger than average in the Pontotoc Ridge test.

The yield in the Central Station test at State College averaged 724 pounds of lint per acre. Rainfall during July at this station was 10.01 inches, 5.27 inches

Brown Loam

Cotton Variety Averages, Brown Loam Branch Station, Raymond.

	Yield per acre, pounds lint						Averages			
							Val. per a./SLM,	Lint	Staple, 32nds.	Bolls per lb
Variety	1956	1957	1960	1962	1963	Average	dollars	percent	inch	lint
Auburn 56	497	983	474	650	1144	750	269	36.7	33.1	206
Stoneville 3202	461	729	532	568	1150	688	237	39.8	31.8	204
Dixie King	552	735	541	406	1053	657	232	37.8	33.1	162
Deltapine 15	403	735	614	496	945	639	224	40.1	33.1	206
Delfos 9169	414	599	465	451	1109	608	222	36.5	34.3	194
Deltapine Sm. Lf.		869	575	543	1175					
DeKalb 108			517	617	1143					
Fox 4			449	592	955					
Coker 100A, WR			490	511	888					
Stoneville 213				698	1373					
DeKalb 220				698	1182					
Stoneville 7A				692	1014					
Carolina Queen				587	1133					
Delta Queen				566	1108					

Cotton Varieties, Brown Loam Branch Station, Raymond, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound		Pct.
Variety	Seed cotton	lint	val. per A., slm	lint pct.	32 nds inch	seed cotton	lint	first picking
Empire WR. 61	4011	1477	546	36.8	34.3	56	153	60
Stoneville 213	3510	1373	495	39.1	33.7	73	187	81
DeKalb 220	3156	1182	436	37.4	34.3	66	178	82
Deltapine Sm. Lf	3045	1175	431	38.5	34.0	75	195	84
Stoneville 3202	2986	1150	415	38.5	33.3	74	193	84
Auburn 56	3245	1144	427	35.2	34.0	68	194	81
DeKalb 108	3104	1143	423	36.8	34.0	63	172	83
Carolina Queen	2946	1133	416	38.4	34.7	63	164	82
Deltapine 45	2837	1120	409	39.4	34.0	70	177	78
Delfos 9169	3268	1109	420	33.9	35.0	64	190	86
Delta Queen	2972	1108	409	37.2	34.3	67	182	80
Coker 124B	2890	1058	392	36.6	34.3	68	187	81
Auburn M	2900	1056	391	36.4	34.0	70	193	87
Dixie King	2916	1053	385	36.1	33.7	58	161	80
Rex Smooth Leaf	2855	1052	389	36.8	34.0	63	172	84
Stoneville 7A	2547	1014	364	39.8	33.7	69	174	73
Fox 4	2560	955	347	37.2	33.7	69	186	74
Deltapine 15	2426	945	346	38.9	34.0	76	196	70
Coker 100 A, WR.	2395	888	328	37.1	34.3	65	176	82
LSD at 5%		287						
CV.		22.7%						

Planted April 19, planted over May 2; poisoned 9 times; Fertilized 125-65-65; soil, Loring

Northeast Mississippi

Cotton Variety Averages, Northeast Mississippi Branch Station, Verona.

	Yield per acre, pounds lint				Averages			
Variety	1959	1962	1963	Average	Val. per a./SLM, dollars	Lint percent	Staple, 32nds inch	Bolls per lb lint
Stoneville 3202	1255	927	596	926	328	38.5	34.0	190
Dixie King	1162	912	439	838	302	37.1	35.0	150
Fox 4	1037	924	505	822	295	37.7	34.8	181
Auburn 56	1164	736	551	817	295	36.5	34.9	191
Deltapine Sm. Lf	1059	878	489	809	289	39.8	34.8	191
Coker 100A, WR	1156	810	434	800	289	37.5	35.7	184
Deltapine 15	1036	835	460	777	277	39.8	34.9	184
Delfos 9169	1129	807	368	768	281	35.5	36.4	179
Stoneville 7A		946	587					
Stoneville 213		966	499					
Carolina Queen		900	430					
DeKalb 220		848	554					
Delta Queen		883	465					
DeKalb 108		825	453					

Cotton Varieties, Northeast Mississippi Branch Station, Verona, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound	
Variety	Seed cotton	Lint	val. per A., slm	Lint pct.	32nds inch	Seed cotton	Lint
Stoneville 3202	1591	596	216	37.4	33.7	74	197
Stoneville 7A	1595	587	218	36.7	35.0	70	190
DeKalb 220	1533	554	207	36.1	35.3	67	187
Auburn 56	1530	551	206	36.0	35.0	70	194
Fox 4	1391	505	187	36.3	34.7	71	197
Deltapine 45	1294	503	185	38.9	35.0	76	196
Stoneville 213	1390	499	187	35.9	35.7	71	200
Empire WR 61	1383	489	182	35.3	34.3	59	169
Deltapine Sm. Lf	1291	489	180	37.9	34.3	79	209
Delta Queen	1301	465	174	35.8	35.3	70	195
Deltapine 15	1193	460	168	38.5	34.7	78	204
DeKalb 108	1257	453	168	36.0	34.0	66	185
Coker 124B	1219	442	165	36.3	35.0	70	194
Dixie King	1226	439	163	35.8	34.7	56	157
Coker 100A WR.	1188	434	162	36.5	35.7	69	189
Carolina Queen	1146	430	158	37.5	34.3	64	172
Auburn M	1155	403	151	34.9	34.7	69	198
Rex Smooth Leaf	1133	389	147	34.3	35.0	62	181
Delfos 9169	1095	368	141	33.6	36.3	66	196
LSD at 5%		NS					
CV.		29.5%					

Planted May 10; poisoned 7 times; fertilized 78-108-72; soil, Iuka silt loam.

above normal. Most of this came during the latter half of the month just as the crop was at its peak of fruiting. The plants grew abnormally large. Excessive shedding of fruit occurred and is thought to have been caused mostly by prolonged saturation of the soil and the shading effect of the cloudy weather which accompanied the heavy rainfall. Incidently, the number of squares punctured by weevils increased from 2 percent on July 5 to 15 percent on July 23. The large plants became tangled and were damaged by the regular tractor equipment used in poisoning. The weather was dry at State College except during July.

Cotton in the test at the Northeast Branch Station, Verona was damaged severely by five overflows. Two replications had to be discarded and the water damage in the remaining four caused so much variation between the yields of the same varieties in different replications that the differences between varieties were not statistically significant even though they were quite high in some cases.

All tests were planted in randomized complete blocks with six replications except those at Holly Springs where eight replications were planted. Only four replications were harvested for record at the Northeast Mississippi Branch Station at Verona. Plots were single rows varying in length from 60 to 200 feet and in width from 36 to 42 inches.

Pontotoc

Cotton Variety Averages, Pontotoc Ridge, Pontotoc-Ridge Flatwoods Branch Station, Pontotoc.

	Yield per acre, pounds lint						Averages			
							Val. per a./SLM,	Lint	Staple, 32nds.	Bolls per lb
Variety	1959	1960	1961	1962	1963	Average	dollars	percent	inch	lint
Coker 100A, WR.	946	534	1066	578	991	823	276	38.3	34.9	178
Auburn 56	878	566	1010	648	939	808	280	36.7	34.5	183
Dixie King	892	549	959	590	944	787	271	37.8	34.3	147
Stoneville 3202	798	603	986	553	988	786	267	38.6	33.4	188
Fox 4	751	547	1050	662	824	767	268	37.7	34.1	183
Deltapine Sm. Lf	746	569	928	593	843	736	256	39.5	34.7	192
Deltapine 15	644	557	935	516	831	697	242	39.4	34.1	189
Delfos 9169	738	449	742	574	784	657	234	36.1	35.4	175
DeKalb 108		530	1014	667	939					
Stoneville 7A			1007	639	894					
DeKalb 220			994	681	888					
Delta Queen			968	564	907					
Carolina Queen				700	1056					
Stoneville 213				695	919					

Cotton Varieties, Pontotoc Ridge, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound	
Variety	Seed cotton	Lint	val. per A., slm	Lint pct.	32nds inch	Seed cotton	Lint
Carolina Queen	2724	1056	387	38.7	34.3	61	159
Auburn M	2799	1039	384	37.1	34.7	59	160
Coker 100A WR	2638	991	368	37.5	35.7	61	163
Stoneville 3202	2597	988	358	38.0	33.6	65	173
Rex Smooth Leaf	2569	949	353	36.9	35.7	52	142
Dixie King	2547	944	349	37.0	34.3	51	139
DeKalb 108	2522	939	347	37.2	34.7	55	149
Auburn 56	2637	939	352	35.6	35.3	63	177
Stoneville 213	2414	919	338	38.0	34.7	66	174
Deltapine 45	2380	913	337	38.3	35.0	65	170
Delta Queen	2463	907	338	36.8	35.0	58	157
Stoneville 7A	2321	894	330	38.5	35.3	62	163
Coker 124B	2428	892	332	36.7	35.3	59	162
DeKalb 220	2411	888	334	36.8	36.3	57	155
Empire WR 61	2313	854	318	36.9	35.3	49	134
Deltapine Sm. Lf	2261	843	311	37.3	34.7	71	191
Deltapine 15	2181	831	305	38.1	34.0	68	179
Fox 4	2292	824	306	35.9	34.3	63	175
Delfos 9169	2304	784	300	34.0	36.0	54	160
LSD at 5%		85					
CV.		8.2%					

Planted May 4; poisoned 4 times; fertilized 82-60-60; soil, Atwood

Cotton Variety Averages, Flatwoods, Pontotoc, Ridge-Flatwoods Branch Station, Pontotoc.

	Yield per acre, pounds lint						Averages			
Variety	1959	1960	1961	1962	1963	Average	Val. per a./SLM, dollars	Lint percent	Staple, 32nds. inch	Bolls per lb lint
Dixie King	735	505	738	512	787	655	236	38.2	33.6	151
Auburn 56	733	491	766	535	710	647	233	37.3	33.5	192
Stoneville 3202	694	448	818	513	697	634	209	40.0	32.6	194
Coker 100A, WR	686	466	853	470	691	633	228	38.6	34.0	185
Deltapine Sm. Lf	683	495	721	436	668	601	213	40.0	33.4	197
Fox 4	660	458	663	504	646	586	211	38.0	33.5	192
Delfos 9169	659	408	627	449	597	548	202	36.6	35.0	176
Deltapine 15	585	395	639	353	573	509	182	39.9	33.9	193
Dekalb 108		499	790	527	695					
DeKalb 220			784	487	799					
Delta Queen			786	492	752					
Stoneville 7A			701	494	693					
Carolina Queen				528	789					
Stoneville 213				526	777					

Cotton Varieties, Flatwoods, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1963

	Yield per A., lbs.		Dollar		Staple	Bolls per pound	
Variety	Seed cotton	Lint	val. per A., slm	Lint pct.	32nds inch	Seed cotton	Lint
DeKalb 220	2207	799	297	36.2	34.3	61	168
Carolina Queen	2059	789	291	38.3	35.3	69	180
Dixie King	2214	787	293	35.5	34.3	54	153
Stoneville 213	1976	777	284	39.3	34.7	75	192
Auburn M	2051	752	278	36.6	34.3	65	177
Delta Queen	2013	752	279	37.3	35.7	65	175
Empire WR. 61	1987	727	269	36.5	34.3	53	147
Deltapine 45	1856	719	263	38.7	34.0	64	166
Rex Smooth Leaf	1970	718	266	36.4	34.7	58	161
Auburn 56	1972	710	260	36.0	33.7	70	196
Coker 124B	1885	709	263	37.6	35.7	65	175
Stoneville 3202	1811	697	252	38.4	33.3	69	181
DeKalb 108	1950	695	259	35.6	34.3	59	166
Stoneville 7A	1789	693	255	38.7	35.0	69	180
Coker 100A WR.	1855	691	255	37.2	34.7	66	178
Deltapine Sm. Lf.	1789	668	246	37.3	34.7	71	190
Fox 4	1749	646	239	36.9	34.7	61	165
Delfos 9169	1742	597	228	34.2	36.0	57	168
Deltapine 15	1506	573	210	38.0	34.7	68	179
LSD at 5%		116					
CV.		14.4%					

Planted May 9; poisoned 4 times; fertilized 62-48-48; soil, Providence

Two pickings were made at State College, Brooksville, Newton, Raymond and Holly Springs. The percent picked at the first picking is reported as an indication of earliness. Auburn M, Rex Smooth Leaf, Empire WR 61, Stoneville 3202, and Auburn 56 are usually a little earlier than most of the others but this difference is not outstanding. A variety which makes its crop early has an advantage in dry years when the soil dries out early or under heavy insect infestation but this characteristic would be a disadvantage under favorable late season conditions.

Lint percentage, boll size and classers samples were obtained from 100 boll samples, one of which was taken from each of three replications in each test except at Verona where only two samples were taken. Staple lengths reported are the average of determinations of three professional cotton classers each

North Mississippi

Cotton Variety Averages, Bottom Land, North Mississippi Branch Station, Holly Springs.

						Averages		
	Yield per acre, pounds lint				Val. per a./SLM,	Lint	Staple, 32nds	Bolls per lb.
Variety	1961	1962	1963	Average	dollars	percent	inch	lint
DeKalb 220	1102	864	1012	993	380	36.2	35.5	164
Stoneville 3202	1153	838	924	972	354	37.7	33.5	170
Coker 100A	1124	792	990	969	360	36.9	35.5	171
Auburn 56	1113	811	939	954	353	36.2	34.5	178
DeKalb 108	1116	809	913	946	351	35.7	34.7	160
Delta Queen	1044	718	989	917	343	36.0	35.5	176
Stoneville 7A	954	774	1009	912	336	38.0	35.1	182
Deltapine Sm. Lf	970	743	951	888	328	37.6	35.1	187
Delfos 9169	1010	672	892	858	326	33.8	36.1	170
Dixie King	983	753	833	856	320	35.9	35.3	150
Fox 4	983	587	896	822	305	35.7	34.3	183
Deltapine 15	928	730	824	794	291	38.1	34.6	183
Stoneville 213		937	1087					
Carolina Queen		800	1067					

Cotton Varieties, Bottom Land, North Mississippi Branch Station, Holly Springs, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound		Pct.
Variety	Seed cotton	lint	val. per A., slm	lint pct.	32 nds. inch	seed cotton	lint	first picking
Stoneville 213	2651	1087	397	41.0	35.3	61	148	75
Carolina Queen	2810	1067	399	38.0	36.3	59	155	78
DeKalb 220	2808	1012	382	36.0	36.7	56	157	77
Stoneville 7A	2620	1009	376	38.5	36.3	70	182	66
Coker 100A WR	2665	990	372	37.1	36.3	60	163	76
Delta Queen	2776	989	375	35.6	36.3	58	163	77
Coker 124B	2672	959	365	35.9	37.0	60	169	75
Deltapine Sm. Lf	2490	951	355	38.2	36.0	67	176	72
Auburn 56	2629	939	352	35.7	35.0	64	179	80
Stoneville 3202	2448	924	340	37.7	34.3	59	158	83
Deltapine 45	2442	920	341	37.6	35.0	62	165	75
Auburn M	2753	918	349	33.3	35.0	59	178	84
DeKalb 108	2572	913	343	35.5	35.3	54	154	77
Fox 4	2494	896	333	35.9	34.3	61	171	76
Delfos 9169	2673	892	345	33.3	37.3	54	163	75
Rex Smooth Leaf	2413	857	321	35.5	35.0	54	154	79
Dixie King	2304	833	314	36.1	36.3	52	144	76
Empire WR 61	2323	832	311	35.8	35.3	47	131	76
Deltapine 15	2190	824	306	37.6	35.3	70	188	64
LSD at 5%		74						
CV.		10.9%						

Planted May 3; poisoned 10 times; fertilized 72-48-48; soil, Collins.

representing a different organization and in general stapling samples from different replications. Lint values are figured from the local loan price for Strict Low Middling cotton of the staple reported for the respective varieties for the respective locations. Seed were figured at $54 per ton.

Data for the 1963 tests as well as for three to five year averages are shown in the accompanying tables. A blank space in the tables indicates that the variety was not in the test that year or the full number of years. The term LSD @ 5% means least significant difference at the five percent level and statistically the odds are 19 to 1 that a difference between two varieties of less than the amount shown is not a real difference but is due to chance. CV means

Cotton Variety Averages, Hill Land, North Miss. Branch Station, Holly Springs.

	Yield per acre, pounds lint						Averages			
							Val. per a./SLM,	Lint	Staple, 32nds.	Bolls per lb.
Variety	1959	1960	1961	1962	1963	Average	dollars	percent	inch	lint
Auburn 56	853	779	867	785	779	813	291	37.3	34.3	189
Stoneville 3202	858	711	827	694	745	767	266	39.5	33.1	192
Coker 100A, WR.	784	755	811	726	750	765	275	38.4	34.8	185
Dixie King	779	811	771	633	705	740	264	37.4	34.1	156
Delfos 9169	706	747	786	669	692	720	263	36.1	35.4	181
Deltapine Sm. Lf.	771	713	858	503	685	706	250	39.1	34.3	198
Fox 4	831	694	743	596	626	698	248	37.6	34.3	193
Deltapine 15	717	685	655	515	679	650	230	39.0	34.1	195
DeKalb 108		803	805	639	800					
Stoneville 7A			827	713	820					
DeKalb 220			813	723	804					
Delta Queen			831	682	772					
Stoneville 213				766	788					
Carolina Queen				677	797					

Cotton Varieties, Hill Land, North Mississippi Branch Station, Holly Springs, 1963.

	Yield per A., lbs.		Dollar		Staple	Bolls per pound		Pct.
Variety	Seed cotton	lint	val. per A., slm	lint pct.	32 nds. inch	seed cotton	lint	first picking
Auburn M	2251	845	307	37.5	33.7	69	184	91
Stoneville 7A	2034	820	293	40.3	33.7	76	188	77
DeKalb 220	2113	804	291	38.0	33.7	69	183	80
DeKalb 108	2114	800	294	37.8	34.0	66	175	82
Rex Smooth Leaf	2113	797	293	37.7	34.0	63	167	87
Carolina Queen	2005	797	290	39.7	34.3	72	182	81
Stoneville 213	1982	788	287	39.7	34.3	78	197	81
Auburn 56	2105	779	288	37.0	34.0	70	191	83
Coker 124B	2069	774	285	37.4	34.7	70	188	79
Delta Queen	2082	772	285	37.1	34.3	67	182	78
Coker 100A WR	1973	750	276	38.0	34.3	69	183	74
Stoneville 3202	1811	745	266	41.1	33.3	72	176	84
Dixie King	1870	705	260	37.7	34.0	56	150	67
Delfos 9169	1960	692	258	35.3	34.0	63	179	64
Deltapine Sm. Lf	1830	685	253	37.4	34.3	74	199	79
Deltapine 15	1779	679	249	38.1	34.3	71	188	79
Empire WR 61	1695	661	238	39.0	33.7	57	147	69
Deltapine 45	1620	651	233	40.1	33.7	74	186	67
Fox 4	1681	626	231	37.2	34.3	71	190	65
LSD at 5%		58	CV				10.7%	

Planted April 26; poisoned 15 times; fertilized 72-48-48; soil, Grenada silt loam.

coefficient of variation and the smaller it is the more reliable the test.

Producers in the hill section of Mississippi should be able to select a good variety to plant by studying these tables. The averages tables showing performance over several years should be more reliable but for the new varieties the 1963 tables must be used. The performance of the varieties in the tests grown under conditions most like one's own farm should be the more reliable indication of what to expect on that farm.

Wilt resistance is very important on land where this disease is a problem. Among the entries in these tests, Auburn 56, Auburn M, Coker 100A and Carolina Queen are probably the most resistant to the Fusarium wilt which is the most common wilt disease in this area. DeKalb 108, Delta Queen, Dixie King, Empire WR 61, and Rex Smooth Leaf are resistant to this disease, also. No commercial varieties are resistant to Verticillium

Coastal Plain

Cotton Variety Averages, Coastal Plain Branch Station, Newton.

Variety	Yield per acre, pounds lint 1958	1959	1960	1961	1963	Average	Averages Val. per a./SLM, dollars	Lint percent	Staple, 32nds. inch	Bolls per lb. lint
Auburn 56	270	623	545	496	970	581	206	37.1	33.3	190
Stoneville 3202	212	585	516	459	927	540	189	39.0	32.9	198
Dixie King	220	589	549	432	884	535	190	37.8	33.7	155
Deltapine Sm. Lf.	204	586	492	472	878	526	186	39.9	33.8	201
Deltapine 15	165	521	519	353	817	475	166	39.7	33.3	199
Delfos 9169	127	528	502	364	759	456	165	36.5	35.1	183
Coker 100A, WR.		566	502	441	955					
Fox 4		543	493	451	845					
DeKalb 108			535	473	858					
DeKalb 220				492	977					
Delta Queen				443	942					
Stoneville 7A				468	866					

Cotton Varieties, Coastal Plain Branch Station, Newton, 1963.

Variety	Yield per A., lbs. Seed cotton	lint	Dollar val. per A., slm	lint pct.	Staple 32 nds. inch	Bolls per pound seed cotton	lint	Pct. first picking
Carolina Queen	2611	1038	378	39.7	34.7	77	193	78
DeKalb 220	2652	977	364	36.8	35.3	71	193	77
Auburn 56	2570	970	357	37.7	34.0	76	202	79
Rex Smooth Leaf	2360	967	353	40.9	35.0	67	164	73
Auburn M	2563	965	355	37.6	34.3	70	188	78
Coker 100A WR.	2533	955	352	37.7	34.3	75	199	74
Stoneville 213	2456	955	344	38.8	33.7	78	203	72
Coker 124B	2475	945	347	38.1	34.7	75	196	75
Delta Queen	2496	942	349	37.7	35.0	73	194	74
Stoneville 3202	2495	927	342	37.1	34.0	80	216	79
Empire WR.61	2426	911	336	37.5	34.3	68	182	77
Dixie King	2501	884	330	35.3	34.0	61	174	75
Deltapine Sm. Lf.	2242	878	321	39.1	34.3	86	220	74
Stoneville 7A	2199	866	316	39.3	34.3	76	194	68
DeKalb 108	2278	858	316	37.6	34.3	67	179	76
Fox 4	2278	845	308	37.1	33.7	77	209	63
Deltapine 15	2100	817	299	38.9	34.0	81	209	68
Delfos 9169	2099	759	284	36.1	35.7	67	186	71
Deltapine 45	1835	710	260	38.7	34.0	80	207	67
LSD at 5%		114	CV.				11.1%	

Planted April 15; poisoned 9 times; soil, Stough loam; fertilized 72-72-72, borated.

wilt which is sometimes serious in certain localities. Coker 100A and Delta Queen are described as having some tolerance to it and Deltapine 45 was, according to its breeders, selected for its high yields where Verticillium wilt is a problem.

Original source of seed

Auburn 56—Alabama Agricultural Experiment Station, Auburn, Alabama.

Auburn M—Foundation Seed Stocks, Columbia, Missouri.

Carolina Queen, Delta Queen, Coker all strains—Coker's Pedigreed Seed Co., Hartsville, South Carolina.

DeKalb 108 and 220—DeKalb Agri. Association, Bogart, Georgia.

Deltapine all strains and Fox 4—Delta and Pine Land Co., Scott, Mississippi.

Dixie King—Bobshaw Pedigreed Seed Co. Indianola, Mississippi.

Empire WR 61—Empire Pedigreed Seed Co. Haralson, Georgia.

Rex Smooth Leaf—Cotton Branch Experiment Station, Marianna, Arkansas.

Stoneville all strains & Delfos 9169—Stoneville Pedigreed Seed Company, Stoneville, Mississippi.

BULLETIN 680 JANUARY 1964

Mississippi Hybrid Corn Tests, 1963

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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COOPERATIVE PROJECT

Corn breeding and testing in Mississippi is a cooperative project between the U. S. Department of Agriculture and the Mississippi Agricultural Experiment Station. In addition to Dr. Grogan and Dr. Campbell, who are listed as authors of this report, the following research men supervised the tests at the various branch stations or participated in it at State College.

Donald H. Bowman, agronomist, Delta Branch Experiment Station, Stoneville.

W. A. Douglas, and C. A. Henderson, entomologists, U.S.D.A., State College, Mississippi.

S. P. Crockett, superintendent, North Mississippi Branch Station, Holly Springs.

Robert C. Albritton, superintendent, Northeast Mississippi Branch Station, Verona.

B. C. Hurt, superintendent, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

Louie Walton, superintendent, Black Belt Branch Station, Brooksville.

B. E. Waggoner, asst. agronomist, Coastal Plain Branch Station, Newton.

Robert E. Coats, agronomist, Brown Loam Branch Station, Raymond.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville.

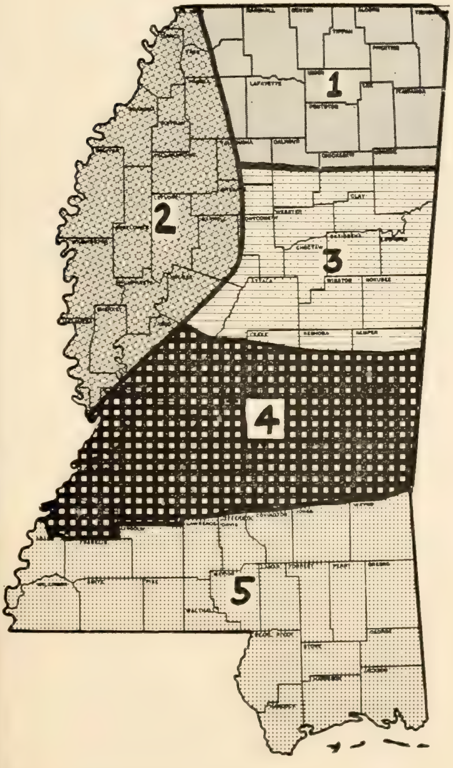
Three of the tests were on private farms through the cooperation of P. F. Williams, Jr., Clarksdale; E. T. Schaefer, Yazoo City; and M. A. Luter, Tylertown.

1963 HYBRID CORN TESTS

By . O. GROGAN AND C. M. CAMPBELL[1]

The southern one-half of Mississippi experienced a very unfavorable season for corn production. Difficulties were encountered in other areas of the state also to give two consecutive years of drought during the growing season. Certain areas, however, had exceptionally good rainfall distribution and excellent yields were reported.

The 1963 main hybrid tests were grouped, as in 1962, in 5 areas on the basis of soil types and certain climatological factors. At least two tests were located in each area. The system is giving very satisfactory results and is well received by farmers and commercial seedsmen. No restrictions were imposed on the number of hybrids entered by any one company in 1963. The greater flexibility in testing procedures will benefit all individuals concerned with the production, distribution, and consumption of hybrid seed corn.



See appropriate table for your area of state.

Five replications of each hybrid were planted in a randomized block design at all locations except Stoneville, Poplarville, and Tylertown where the hybrids were planted in a balanced lattice design with 6 replications. The individual plots were check-planted in 2 x 5 hills to facilitate ease of planting, obtaining a uniform population, taking notes, and in making the necessary calculations of performance. Check and drill-type plantings at a given plant population will give comparable results. The data from Clarksdale will not be reported since the test was ruined by thieves.

In addition to yield, notes were taken on root and stalk lodging, ear height, ears per plant, moisture in the grain, percent stand, and insect damage. The most recent and highly destructive insect is the Southwestern corn borer. Work is in progress to determine which cultural practices will reduce losses and to search for corn that shows some de-

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[1] Agronomists, Crops Research Division, U. S. Department of Agriculture and the Mississippi Agricultural Experiment Station. Cooperative research was with the Entomology Division, Agricultural Research Service, U. S. Department of Agriculture. The tests were conducted jointly with the Branch Experiment Stations and on three private farms. See opposite page.

Summary performance of the main hybrid tests in area 1 (Holly Springs, Verona, and Pontotoc Ridge and Flatwoods), 1963

Hybrid	Acre yield	Lodging root	Lodging stalk	Ear ht.	Ears per plant	Moist. in grain	Stand	Earworm Penetration[1]	Earworm Ears infested	P.C.W.[2] ears infested	Husk Extension[3]	Husk Tightness[4]	S.W.C.B.[5] Infested	S.W.C.B.[5] Girdled
	Bu.	%	%	Ft.	No.	%	%	In.	%	%	In.	In.	%	%
Funks G-795W	73.5	.3	9.4	3.6	1.5	12.2	95	0.5	55	68	2.9	0.82	8.4	0.0
Embro Depart VIII	73.3	3.6	21.7	3.9	2.3	12.1	99	0.5	55	55	2.5	0.74	6.0	1.2
Miss. 6135 (Exp.)	71.2	0.0	16.8	4.3	1.6	11.7	96	0.7	50	60	2.7	0.70	10.5	5.3
Pioneer 509W	70.9	.3	13.0	3.6	1.2	11.7	97	2.0	80	93	1.3	1.13	9.8	2.4
Delta 9907 (Exp.)	68.5	0.0	6.6	4.3	1.5	12.3	97	0.8	73	83	2.9	0.64	12.3	2.5
Dixie 55	68.3	0.0	15.6	4.5	1.4	12.1	96	0.9	73	80	3.0	0.73	5.8	3.5
Dixie 77	68.0	.5	17.7	3.9	1.3	12.5	91	0.9	65	78	2.5	0.75	7.5	2.5
Pioneer 3037 (9187)	66.6	0.0	17.7	3.8	1.4	12.8	95	0.8	73	75	2.4	0.79	12.0	3.6
Embro Jarvis E	66.1	.2	13.1	3.1	1.1	11.8	98	1.8	85	95	1.5	1.04	14.1	2.2
McCurdy M97	65.0	1.7	19.0	3.7	1.1	11.5	99	1.3	78	85	1.9	1.04	17.4	5.8
Pioneer 8224	64.6	0.0	19.8	3.6	1.3	12.4	98	0.6	53	65	2.5	0.74	10.1	0.0
Miss. 6133 (Exp.)	64.4	.3	20.1	4.0	1.5	11.7	96	0.6	55	68	3.3	0.66	11.7	1.3
Pioneer 3048 (8218)	63.4	.5	12.3	4.0	1.1	12.7	96	0.8	75	78	3.2	0.68	11.1	5.0
Pioneer 309B	63.2	0.0	13.3	3.4	1.2	12.5	96	1.2	70	75	2.2	0.91	15.5	8.3
DeKalb 1212	62.2	.5	12.7	4.4	1.1	12.5	92	1.0	65	78	2.2	0.76	18.9	8.9
Stulls 111YA	61.1	0.0	14.6	4.2	1.1	12.2	95	1.2	78	88	2.5	0.91	15.1	3.5
Embro 222TA	60.7	.5	10.2	4.0	1.0	12.1	97	0.9	63	85	2.4	0.78	8.5	1.2
Funks G-580W	60.6	.3	9.8	3.4	1.2	12.3	98	1.0	73	78	2.2	0.81	2.4	0.0
Funks G-711AA	60.6	.2	23.2	3.8	1.1	12.2	93	1.5	80	90	1.6	1.08	9.6	2.4
Pioneer 310	60.1	.3	11.4	3.1	.9	11.4	92	1.9	90	95	1.5	1.07	13.2	6.6
Stulls 500W	59.3	0.0	24.4	3.5	.9	12.2	97	1.3	78	88	2.3	0.87	12.9	4.3
McCurdy 999	59.3	.5	20.5	3.6	1.0	11.6	96	1.0	53	60	2.1	0.96	6.2	1.2
McCurdy 7X11	59.0	0.0	9.2	3.0	1.0	11.3	95	2.2	88	93	1.2	1.26	14.1	1.3
Dixie 22	59.0	0.0	18.9	4.2	1.0	12.6	92	1.1	70	85	2.4	0.77	9.6	4.3
McCurdy 972X7	58.3	.3	10.4	3.6	.9	11.4	95	1.8	90	90	1.7	1.10	13.9	3.5
McNair 304A	58.2	.5	10.2	3.3	1.0	12.6	91	0.7	60	73	2.5	0.78	15.7	8.4
Funks G-707	57.7	0.0	16.4	3.4	1.1	12.2	94	1.5	80	85	1.9	0.95	11.1	2.5
Embro Jarvis L	57.1	.5	23.2	4.0	1.1	12.1	96	0.8	55	75	2.7	0.98	12.6	0.0
DeKalb 1213	55.3	.3	9.4	4.2	1.1	12.5	94	0.7	70	78	3.0	0.68	22.5	5.6
Embro Low Boy	54.9	0.0	9.7	3.8	1.1	12.5	93	1.1	65	75	2.9	0.71	12.2	4.9
Mean	63.0	0.4	15.0	3.7	1.2	12.1	95	1.1	70	79	2.3	0.86	11.8	3.4

[1]Penetration from tip of ear. [2]Pink corn worm. [3]Extension beyond tip of ear. [4]Diameter of silk channel at tip of ear.

gree of resistance.

Although corn stunt has been identified in Mississippi, its appearance is recent and no recommendations as to variety resistance can be made at this time.

The significance of the number of ears per plant is often not well understood. As a general rule, the hybrids which produce the largest number of ears per plant at a given population are the ones which give the highest yields during stress as well as optimum conditions.

The importance of planting corn early in Mississippi cannot be ignored. Tests conducted for a number of years reveal that the early-planted corn will give the best yields and will have less lodging and insect damage at harvest. In a corn-cotton farming program, corn easily can be planted before cotton and harvested before cotton. If the farmer disposes of the corn as a cash crop, he will be in a position to take advantage of the higher early market.

Several factors should be considered in selecting a hybrid or hybrids. Yield is one prime consideration but by no means the only one. However, when yield is considered, the three-year average is much more important than the information of one location or the Area average for one year. Lodging resistance, insect resistance (especially in some areas), and other characteristics are important and should be weighed according to the farming operations. Finally, time of planting and an adequate fertilizer program are essential in making an adapted hybrid produce its maximum potential.

Summary performance of the main hybrid test at Stoneville (Exp. 306). Area 2*, 1963.

Hybrid	Acre yield 3-Yr. mean	Acre yield 1963	Lodging Stalk	Ear ht.	Ears per plant	Stand	Earworm Penetration[1]
	Bu.	Bu.	%	Ft.	No.	%	In.
Miss 6131 (Exp.)	......	156.4	43.0	4.5	2.3	100	1.0
Miss 6135 (Exp.)	.	134.0	41.0	4.2	2.4	96	1.0
Delta 9907 (Exp.)	111.3	133.2	34.0	4.2	2.0	100	1.0
Dixie 55	111.1	131.0	41.0	4.2	2.1	97	1.0
Funks G-795W	115.2	122.3	76.0	3.8	2.0	90	1.2
DeKalb 1212	......	121.5	33.0	4.8	1.7	98	1.5
Miss. 0002 (Exp.)	114.4	119.4	70.0	4.0	2.0	90	1.3
Coker 67	104.3	114.4	23.0	4.0	1.8	97	0.7
Dekalb 1225	103.5	113.8	43.0	4.7	1.7	95	0.7
Funks G-732	......	113.0	33.0	4.0	1.6	99	1.0
Pioneer 309B	99.5	112.4	49.0	3.5	1.7	96	1.8
Pioneer 3048 (8218)	......	111.7	43.0	4.2	1.5	97	1.5
Dekalb 1213	......	111.2	25.0	4.7	1.7	94	0.7
Embro 222TA	......	109.2	32.0	4.0	1.2	98	2.0
McCurdy M97	......	109.1	40.0	3.5	1.5	90	1.8
Funks G-711AA	95.9	108.6	31.0	4.0	1.5	88	1.7
Funks G-580W	......	106.7	51.0	3.7	1.5	87	1.0
Pioneer 3037 (9187)	......	106.7	58.0	3.2	1.6	96	1.5
Funks G-707	......	105.0	21.0	3.5	1.5	96	1.2
Dixie 77	103.6	104.6	60.0	3.8	1.7	85	1.0
Dixie 22	98.2	104.2	47.0	4.3	1.7	91	1.0
McCurdy 999	93.5	103.2	50.0	3.7	1.4	97	1.3
Embro Low Boy	......	98.5	49.0	4.0	1.6	91	1.0
Coker 911	95.6	94.2	70.0	3.8	1.6	86	1.3
McNair 304A	. .	93.8	36.0	3.3	1.3	88	1.0
Mean		108.4	44.0	4.0	1.7	94	1.2
C.V. 9% LSD, 5%		11.6					

[1] Inches from tip of ear.

*Data from Clarksdale not included since the test was damaged by thieves.

Summary performance of the main hybrid tests in Area 3 (State College and Brooksville), 1963.

Hybrid	Acre yield	Lodging root	Lodging stalk	Ear ht.	Ears per plant	Moist. in grain	Stand	Earworm Penetration[1]	Earworm Ears infested	P.C.W.[2] ears infested	Husk Extension[3]	Husk Tightness[4]	S.W.C.B.[5] Infested	S.W.C.B.[5] Girdled
	Bu.	%	%	Ft.	No.	%	%	In.	%	%	In.	In.	%	%
Dixie 82	130.4	4.9	4.5	4.8	1.9	13.3	96	1.2	95	90	3.4	0.56	25.0	5.0
Miss. 0002 (Exp.)	125.6	.4	6.1	4.3	1.8	13.1	100	0.8	75	73	3.7	0.59	11.1	0.0
Dixie 55	122.6	1.2	7.3	4.6	1.8	12.7	99	1.1	88	75	3.0	0.59	21.6	10.8
Delta 9907 (Exp.)	121.1	0.0	1.5	4.3	1.8	12.8	100	1.0	88	70	2.9	0.59	25.0	10.0
Funks G-795W	121.0	1.4	7.9	3.6	1.7	13.2	98	1.1	78	70	3.3	0.61	10.5	2.6
Riemers 305	118.3	3.0	6.9	4.4	1.8	12.5	97	1.1	88	85	3.6	0.60	20.0	5.7
Funks G-14486	111.3	1.4	6.5	4.5	1.6	13.3	100	1.1	90	85	2.1	0.76	40.5	16.2
Pioneer 3048 (8218)	107.2	2.0	1.5	3.8	1.3	12.2	100	1.4	93	85	3.0	0.64	32.4	13.5
Dixie 18	104.3	1.4	3.9	4.7	1.6	13.2	100	0.6	68	75	3.3	0.59	44.7	13.2
Funks G-720	103.2	1.0	2.0	3.7	1.3	12.6	99	1.1	88	80	2.5	0.78	27.5	15.0
Funks G-732	102.7	5.7	1.2	3.9	1.4	13.0	100	1.5	85	88	2.3	0.74	25.0	12.5
Embro Jarvis L	102.4	1.5	4.1	3.9	1.4	12.3	99	1.0	80	78	2.9	0.66	19.5	0.0
DeKalb 1212	102.2	4.9	2.3	4.6	1.3	12.7	100	1.0	80	75	3.3	0.60	41.5	2.2
McNair 425	102.0	.7	1.9	4.0	1.5	12.7	100	1.1	83	90	2.5	0.74	31.0	9.5
DeKalb 1213	101.6	2.1	2.4	4.8	1.4	12.3	99	0.9	83	75	2.5	0.75	19.5	2.4
Pioneer 309B	101.4	1.1	2.2	3.3	1.3	12.4	99	1.4	100	80	2.6	0.70	11.4	0.0
Embro 222TA	100.7	3.1	4.5	4.3	1.2	13.1	99	1.2	80	78	2.5	0.72	17.5	0.0
Coker 911	100.2	3.1	9.3	3.9	1.4	13.2	99	0.9	83	80	2.6	0.64	17.5	2.5
Funks G-711AA	99.6	5.1	5.4	4.0	1.2	13.0	99	1.2	95	100	1.6	0.88	21.2	0.0
McCurdy M305	99.3	.9	4.3	4.0	1.3	12.1	100	1.3	90	80	3.0	0.61	13.9	8.3
Funks G-580W	98.7	4.6	6.6	3.4	1.3	12.7	99	1.1	88	83	2.6	0.68	25.7	2.9
Pioneer 3037 (9187)	98.6	2.6	3.5	3.9	1.4	12.8	98	1.3	100	93	2.6	0.70	28.9	5.3
Funks G-707	97.4	4.5	5.9	3.7	1.3	13.3	100	1.1	88	88	2.1	0.78	27.5	5.0
Dixie 22	97.4	6.4	2.4	4.3	1.2	13.1	98	1.2	90	75	3.2	0.62	13.5	8.1
Coker 67	96.8	3.7	3.7	3.9	1.7	13.4	98	0.8	73	95	2.9	0.58	27.2	3.0
McCurdy M310	95.7	8.5	9.6	4.6	1.4	12.5	99	0.8	70	78	3.6	0.55	20.0	0.0
McCurdy M97	92.8	5.6	6.1	3.7	1.1	11.6	96	1.4	100	95	2.7	0.75	24.3	10.8
McCurdy 999	89.9	5.9	9.2	3.7	1.1	12.0	100	1.0	80	90	3.2	0.56	16.2	2.7
McNair 304A	89.7	4.4	3.4	3.3	1.1	13.1	100	1.0	85	83	2.9	0.66	28.6	14.3
Embro Low Boy	86.8	2.1	5.3	3.7	1.3	13.0	98	1.0	85	80	3.3	0.62	19.5	0.0
Mean	104.0	**6.3**	**4.7**	**4.1**	**1.4**	**12.8**	99	1.1	86	82	2.8	0.66	23.7	6.8

[1] Penetration from tip of ear. [2] Pink corn worm. [3] Extension beyond tip of ear. [4] Diameter of silk channel at tip of ear. [5] South West corn borer. Insect notes from State College only.

Summary performance of the main hybrid tests in Area 4 (Yazoo City, Raymond, and Newton), 1963.

Hybrid	Acre yield	Lodging		Ear ht.	Ears per plant	Moist in grain	Stand	Earworm		P.C.W.[2]	Husk	
		Root	Stalk					Penetration[1]	Ears infested	Ears infested	Extension[3]	Tightness[4]
	Bu.	%	%	Ft.	No.	%	%	In.	%	%	In.	In.
Dixie 82	68.5	1.1	11.2	4.0	1.5	10.3	82	1.1	87	100	2.8	.70
Dixie 55	68.2	1.6	13.3	3.7	1.5	9.5	93	1.1	83	100	2.8	.67
Delta 9907 (Exp.)	66.3	.7	6.2	3.3	1.5	9.7	93	1.2	90	100	2.9	.69
Dixie 18	65.6	.3	17.6	3.8	1.4	10.3	91	1.3	84	100	2.5	.73
Funks G-14486	65.4	3.0	4.3	3.8	1.4	10.2	89	1.0	88	100	2.3	.79
Riemers 308	65.4	.3	10.1	3.8	1.4	10.3	90	1.1	**94**	**100**	**2.9**	**.67**
Funks G-745	65.0	5.2	10.8	3.6	1.3	10.2	92	1.0	83	99	2.3	.77
Miss. 0002 (Exp.)	64.5	.3	9.4	3.5	1.4	9.5	92	1.1	84	100	2.8	.69
Funks G-795W	64.4	1.3	12.3	3.0	1.4	10.0	89	1.2	88	100	2.4	.77
Embro Jarvis L	62.1	.3	12.0	3.2	1.2	9.6	92	1.7	82	100	2.1	.77
McCurdy M310	62.1	3.3	15.8	3.7	1.1	9.5	84	1.0	89	99	2.6	.70
McCurdy 1003C	59.6	5.0	16.9	3.8	1.2	9.7	92	1.2	84	99	2.8	.68
McNair 425	59.2	3.7	11.0	3.3	1.4	10.1	90	1.2	93	100	2.4	.76
DeKalb 1213	58.8	1.0	9.0	4.0	1.3	10.3	93	1.0	78	100	2.5	.73
NC 288	58.8	.7	7.7	3.4	1.2	9.4	84	1.3	95	100	2.3	.76
Greenwood 471	58.3	7.3	9.2	3.4	1.2	10.2	87	1.2	92	100	2.7	.72
McCurdy M307	56.9	1.4	7.7	3.8	1.2	10.0	87	1.0	81	100	2.8	.68
*Pion 3048 (8218)	56.4	.3	10.3	3.1	1.1	9.6	91	1.2	94	100	2.4	.67
DeKalb 1212	55.2	.7	7.2	3.8	1.1	9.9	90	1.4	82	100	2.6	.72
Coker 67	54.4	0.0	6.7	3.2	1.4	10.1	93	.8	75	100	2.8	.63
Embro 256CP	54.1	0.0	9.4	3.5	1.2	10.3	86	.9	91	100	2.4	.73
Embro Low Boy	53.7	.8	14.0	3.1	1.2	9.7	82	1.1	72	100	2.9	.66
*Pion 309B	53.3	1.3	5.2	3.0	1.1	9.9	89	1.1	88	100	2.7	.75
Funks G-732	53.2	1.0	6.5	3.2	1.3	10.1	88	1.5	87	100	2.1	.83
Coker 811A	52.9	1.0	5.2	3.3	1.5	10.2	87	.9	76	99	3.3	.60
Dixie 22	52.7	.7	9.7	3.7	1.1	9.9	87	1.3	90	100	2.5	.78
Coker 71	52.0	1.5	6.3	3.4	1.4	10.1	90	.8	82	100	2.4	.68
*Pion 3037 (9187)	52.0	0.0	7.6	3.1	1.3	9.7	91	1.0	86	100	2.5	.73
McNair 304A	49.2	1.0	7.7	2.7	1.0	9.9	84	1.6	82	100	2.9	.71
McCurdy M301-1	44.8	4.6	16.6	3.5	1.1	9.7	87	1.1	83	99	2.7	.72
Mean	58.6	1.6	9.9	3.5	1.3	9.9	89	1.2	86	100	2.6	0.70

*Pioneer

Insect notes from Raymond and Newton, except penetration from 3 locations.

[1] Penetration from tip of ear. [2] Pink corn worm. [3] Extension beyond tip of ear. [4] Diameter of silk channel at tip of ear

Summary performance of the main hybrid tests in Area 5 (Poplarville and Tylertown), 1963.

Hybrid	Acre yield	Lodging		Ear ht.	Ears per plant	Moist in grain	Stand	Earworm		P.C.W.[2]	Husk	
		Root	Stalk					Penetration[1]	Ears infested	Ears infested	Extension[3]	Tightness[4]
	Bu.	%	%	Ft.	No.	%	%	In.	%	%	In.	In.
Funks G-795W	38.9	.9	1.8	3.2	1.0	10.6	94	1.5	100	30	2.4	0.77
Pioneer 3048 (8218)	36.4	0.0	1.9	3.7	.9	10.4	87	1.7	97	60	3.0	0.61
Dixie 55	36.1	1.4	.5	3.7	.9	10.3	88	1.2	97	37	2.5	0.71
Pioneer 3037 (9187)	35.5	.5	2.2	3.7	1.0	10.6	88	1.9	93	50	2.0	0.82
DeKalb 1212	34.4	0.0	1.8	4.0	.9	10.9	88	1.8	100	57	2.5	0.74
Embro 260	33.3	1.0	3.2	3.7	1.0	10.4	80	1.1	80	73	2.7	0.61
Miss. 8288 (Exp.)	33.2	0.0	.9	4.2	.9	10.2	93	1.7	80	80	3.0	0.64
Funks G-745	31.5	0.0	.5	3.8	1.0	10.1	91	2.1	100	43	1.9	0.77
Funks G-14486	31.4	.5	1.4	4.0	.9	10.2	91	1.3	87	60	2.2	0.73
Funks G-740	30.7	.9	2.9	4.2	.9	10.6	90	1.4	87	50	2.8	0.63
McNair 425	30.7	0.0	2.6	3.3	1.0	10.3	85	1.8	90	67	2.3	0.72
Miss. 6002 (Exp.)	29.9	0.0	1.0	3.9	.9	9.8	90	1.4	97	53	3.2	0.60
DeKalb 1213	29.7	.9	.9	4.3	.9	10.6	93	1.5	90	37	2.6	0.69
Funks G-732	29.7	1.3	.5	3.6	.9	10.6	92	2.0	97	40	2.0	0.79
Greenwood 471	29.6	0.0	.6	4.0	.9	10.5	81	1.6	93	70	3.2	0.62
Dixie 18	29.0	0.0	1.5	4.0	.9	10.6	87	1.4	93	63	2.9	0.70
Riemers 408	28.1	0.0	5.0	4.1	1.0	10.4	78	1.6	90	67	3.3	0.60
Miss. 8484 (Exp.)	28.1	.9	3.6	4.3	1.0	10.4	88	1.6	90	50	3.3	0.62
Embro Flint 1	27.6	.9	2.3	4.6	.8	10.9	92	1.0	87	77	2.5	0.60
DeKalb 1225	26.9	1.8	1.4	4.1	.8	10.5	86	1.4	87	63	2.7	0.65
Coker 71	25.7	0.0	1.4	4.0	.8	10.7	91	1.5	90	73	2.7	0.65
Coker 811A	24.7	0.0	0.0	3.9	1.0	10.5	81	1.7	90	77	2.7	0.69
Coker 67	24.1	0.0	.9	4.0	.8	10.5	89	1.6	93	70	2.5	0.67
Coker 811	22.2	0.0	.5	3.8	.8	10.5	93	1.4	83	70	2.7	0.66
Miss. 3001 (Exp.)	21.8	0.0	2.7	4.3	.8	10.1	85	1.7	93	53	2.7	0.69
Mean	30.0	0.5	1.7	3.9	0.9	10.4	88	1.6	91	59	2.7	0.68

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. Insect data from Poplarville only.

Area 1, Corn yields at individual locations, 1963 and 3-year average.

Hybrid	Area Average	Holly Springs	Verona	Pontotoc (Ridge)	Pontotoc (Flatwoods)	3-year Average
			Bushels per acre			
Funk's G-795W	73.5	72.5	50.1	96.8	74.7	....
Embro Departure VIII	73.3	66.4	60.5	86.6	79.6	. .
Miss. 6135 (Exp.)	71.2	73.9	41.1	96.4	73.3	81.9
Pioneer 509W	70.9	71.8	63.5	81.6	66.6	-----
Delta 9907 (Exp.)	68.5	64.9	53.5	90.7	64.8	79.8
Dixie 55	68.3	65.4	43.4	94.1	70.2	80.1
Dixie 77	68.0	67.7	43.1	90.4	70.8	77.0
Pioneer 3037 (9187)	66.6	63.7	48.0	83.9	70.9	-----
Embro Jarvis E	66.1	66.1	53.6	77.5	67.3	----
McCurdy M97	65.0	58.7	52.4	83.0	66.0	-----
Pioneer 8224	64.6	59.8	43.9	87.4	67.2	-----
Miss. 6133 (Exp.)	64.4	49.8	46.3	90.9	70.5	77.2
Pioneer 3048 (8218)	63.4	64.9	45.5	78.6	64.8	-----
Pioneer 309B	63.2	60.0	50.4	80.0	62.5	76.5
DeKalb 1212	62.2	62.6	36.5	82.7	66.9	-----
Stull's 111YA	61.1	64.0	31.8	78.8	69.8	-----
Embro 222TA	60.7	56.0	45.4	76.1	65.4	-----
Funk's G-580W	60.6	69.3	33.4	79.7	60.0	-----
Funk's G-711AA	60.6	56.0	50.9	74.8	60.7	73.5
Pioneer 310	60.1	67.9	29.2	82.2	61.2	-----
Stull's 500W	59.3	61.7	30.0	81.6	64.0	-----
McCurdy 999	59.3	60.2	49.3	68.4	59.3	-----
McCurdy 7 x 11	59.0	60.1	42.6	77.6	55.8	. ..
Dixie 22	59.0	61.6	27.6	80.0	66.6	75.5
McCurdy 972 x 7	58.3	63.7	37.4	72.5	59.5	-----
McNair 304A	58.2	64.8	29.6	74.4	63.8	.. .
Funk's G-707	57.7	53.5	33.7	77.8	65.8	....
Embro Jarvis L	57.1	48.5	39.9	77.6	62.5	----
DeKalb 1213	55.3	47.7	28.7	79.8	64.9	-----
Embro Low Boy	54.9	54.3	29.9	77.4	58.1	-----
Mean	63.0	61.9	42.4	82.0	65.8	----
LSD, 5%	-----	13.1	12.4	10.9	8.9	.

Area 3, Corn yields at individual locations, 1963 and 3-year average.

Hybrid	Area average	State College	Brooksville	3-year average
		Bushels per acre		
Dixie 82	130.4	120.5	140.3	103.7
Miss. 0002 (Exp.)	125.6	110.5	140.6	104.9
Dixie 55	122.6	115.4	129.8	99.3
Delta 9907 (Exp.)	121.1	115.1	127.0	--------
Funk's G-795W	121.0	109.1	132.9	102.4
Riemer's 305	118.3	109.8	126.8	--------
Funk's G-14486	111.3	103.2	119.4	--------
Pioneer 3048 (8218)	107.2	89.7	124.7	--------
Dixie 18	104.3	95.0	113.5	87.3
Funk's G-720	103.2	92.2	114.2	92.8
Funk's G-732	102.7	90.4	114.9	--------
Embro Jarvis L	102.4	95.7	109.0	--------
DeKalb 1212	102.2	95.3	109.0	--------
McNair 425	102.0	89.6	114.4	--------
DeKalb 1213	101.6	98.4	104.8	--------
Pioneer 309B	101.4	93.0	109.8	90.9
Embro 222TA	100.7	89.0	112.4	--------
Coker 911	100.2	83.5	116.8	86.5
Funk's G-711AA	99.6	82.7	116.5	--------
McCurdy M305	99.3	89.9	108.7	--------
Funk's G-580W	98.7	88.7	108.7	--------
Pioneer 3037 (9187)	98.6	90.7	106.5	--------
Funk's G-707	97.4	86.6	108.1	--------
Dixie 22	97.4	88.3	106.4	89.8
Coker 67	96.8	87.6	106.0	86.0
McCurdy M310	95.7	84.4	106.9	--------
McCurdy M97	92.8	83.4	102.2	--------
McCurdy 999	89.9	78.2	101.6	--------
McNair 304A	89.7	79.1	100.3	--------
Embro Low Boy	86.8	81.9	91.7	--------
Mean	104.0	93.9	114.1	--------
LSD, 5%	------	10.0	9.0	--------

Area 4, Corn yields at individual locations, 1963 and 3-year average.

Hybrid	Area Average	Yazoo City	Raymond	Newton	3-Year Average
			Bushels per acre		
Dixie 82	68.5	85.9	54.8	64.8	72.9
Dixie 55	68.2	94.1	47.3	63.1	70.4
Delta 9907 (Exp.)	66.3	111.1	35.8	52.0	—.—
Dixie 18	65.6	83.0	53.6	60.1	66.8
Riemer's 308	65.4	92.8	36.6	66.9	—.—
Funk's G-14486	65.4	91.3	43.7	61.2	—.—
Funk's G-745	65.0	84.0	50.3	60.7	—.—
Miss. 0002 (Exp.)	64.5	93.0	37.9	62.7	71.6
Funk's G-795W	64.4	86.2	42.6	64.5	69.5
Embro Jarvis L	62.1	87.9	43.8	54.5	—.—
McCurdy M310	62.1	90.0	46.4	50.0	—.—
McCurdy 1003C	59.6	77.0	43.7	58.0	62.7
McNair 425	59.2	74.7	39.5	63.3	—.—
NC 288	58.8	81.1	39.1	56.3	65.5
DeKalb 1213	58.8	71.2	44.7	60.4	—.—
Greenwood 471	58.3	81.9	44.3	48.8	—.—
McCurdy M307	56.9	72.7	44.2	53.9	—.—
Pioneer 3048 (8218)	56.4	85.7	32.8	50.6	—.—
DeKalb 1212	55.2	83.8	31.2	50.7	—.—
Coker 67	54.4	69.6	32.8	60.9	62.1
Embro 256CP	54.1	59.3	51.5	51.6	—.—
Embro Low Boy	53.7	81.7	29.3	50.1	—.—
Pioneer 309B	53.3	83.8	28.2	47.9	59.7
Funk's G-732	53.2	76.3	30.0	53.3	—.—
Coker 811A	52.9	69.2	33.1	56.4	—.—
Dixie 22	52.7	66.5	36.4	55.2	60.2
Coker 71	52.0	66.9	30.8	58.4	59.4
Pioneer 3037 (9187)	52.0	69.2	40.9	46.0	—.—
McNair 304A	49.2	62.5	40.4	44.6	—.—
McCurdy M301-1	44.8	56.6	34.5	43.4	—.—
Mean	58.6	80.1	40.0	55.7	—.—
LSD, 5%	—.—	18.1	11.6	13.2	—.—

Area 5, Corn yields at individual locations, 1963 and 3-year average.

Hybrid	Area average	Poplarville	Tylertown	3-year average
		Bushels per acre		
Funk's G-795W	38.9	45.8	32.0	68.9
Pioneer 3048 (8218)	36.4	37.9	34.8	-----
Dixie 55	36.1	39.8	32.3	63.3
Pioneer 3037 (9187)	35.5	36.5	34.4	-----
DeKalb 1212	34.4	38.0	30.8	-----
Embro 260	33.3	39.1	27.5	-----
Miss. 8288 (Exp.)	33.2	27.3	39.1	68.2
Funk's G-745	31.5	36.3	26.6	62.4
Funk's G-14486	31.4	31.6	31.2	-----
Funk's G-740	30.7	34.8	26.5	60.3
McNair 425	30.7	33.6	27.7	-----
Miss. 6002 (Exp.)	29.9	29.2	30.5	62.3
DeKalb 1213	29.7	30.1	29.2	-----
Funk's G-732	29.7	29.6	29.7	-----
Greenwood 471	29.6	30.5	28.6	-----
Dixie 18	29.0	33.1	24.8	64.0
Riemer's 408	28.1	26.1	30.0	-----
Miss. 8484 (Exp.)	28.1	30.0	26.1	68.8
Embro Flint 1	27.6	27.9	27.2	-----
DeKalb 1225	26.9	26.3	27.4	62.6
Coker 71	25.7	34.8	16.5	55.9
Coker 811A	24.7	29.9	19.4	-----
Coker 67	24.1	33.1	15.0	64.6
Coker 811	22.2	28.7	15.6	62.7
Miss. 3001 (Exp.)	21.8	18.1	25.5	-----
Mean	30.0	32.4	27.5	-----
LSD, 5%	-----	7.0	6.6	-----

BULLETIN 681 FEBRUARY 1964

Recommendations for 1964

Weed Control In Cotton

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AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

Nomenclature of Chemicals Used as Herbicides

This list of herbicides is intended only as an aid in obtaining the chemicals. Use of trade names does not imply endorsement of a product by the Mississippi Agricultural Experiment Station, or the U. S. Department of Agriculture and such names are given only for herbicides which, at the time of release of these recommendations, are marketed only under the trade names listed.

Common name	Chemical name of active ingredient	Trade name
CIPC	isopropyl N-(3-chlorophenyl) carbamate	Chloro IPC
dalapon	2,2-dichloropropionic acid	Dowpon
dicryl	3',4'-dichloro-2-methylacrylanilide	Dicryl
DCPA	2,3,5,6-tetrachloroterephthalic acid	Dacthal
diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea	Karmex DL
DMA[1]	disodium monomethylarsonate	Several Mfrs.
herbicidal naphtha[2]	A petroleum naphtha-field-proved sold, and labeled specifically for use in cotton	Several Mfrs.
linuron	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	Lorox
monuron	3-(p-chlorophenyl)-1,1-dimethylurea	Telvar ML
norea	3-(5-(3a,4,5,6,7,7a,-methanoindahyl))-1,1-dimethylurea	Herban
PCP	pentachlorophenol	Several Mfrs.
surfactant	Highly variable; comparative evaluation data by chemical type are very limited. Only nonionic agricultural surfactants, sold specifically for use with herbicides and cleared for use under Public Law 518, are recommended.	

[1] Also known as DSMA

[2] Also known as herbicidal oil

CAUTION

The manufacturer's label gives the number of pounds of active material per gallon of the herbicidal concentrate, or for powders, the percentage of active ingredients. Instructions on the manufacturer's label pertaining to usage and to personal hazards in handling should be read and strictly followed.

1964 WEED CONTROL RECOMMENDATIONS FOR COTTON

V. C. HARRIS, J. T. HOLSTUN, JR., AND C. E. MOORE[1]

Certain fundamental principles and detailed instructions for the control of weeds in cotton are set forth in Mississippi Agricultural Experiment Station Bulletin 612, Weed Control Handbook for Mississippi, February, 1961. The recommendations presented here supplement these recommendations but are complete within themselves except for certain detained instructions.

Control of weeds in cotton is becoming more efficient each year. It is also becoming more complex and requires thorough advance planning and supervision. Both recommendations and **tentative or trial recommendations** will be presented in order to provide growers with all information that can be justifiably released.

Recommendation of a herbicidal treatment means that extensive research and grower trials under a wide range of conditions have been completed with generally favorable results. Practices given an unrestricted recommendation are supported by data which indicate that use of the recommendation will generally be to a growers advantage. Recommendation of a chemical practice does not mean that it will be satisfactory under all weather conditions or other adverse circumstances, but with such practices the limitations are usually known and published. Adverse results due to undiscovered limitations are certainly possible, but the probability of such failures is low.

A tentative, or trial recommendation means that the research data are encouraging enough to warrant limited use of the treatment, but that information with respect to one or more important factors is either missing or insufficient.

The grower must determine for himself the extent to which a tentative recommendation is used, and he should recognize the fact that the chances of adverse results are much greater than with recommended practices.

The problem of weed control in cotton varies considerably from one field to another. A total system of weed control may be a combination of several separate practices. The various practices to be recommended will be grouped according to time and method of application. Combination of these practices into a system of control for a particular field will be left to the individual grower, but information helpful in this respect can be obtained from County Agents and from Bulletin 612.

PREPLANTING TREATMENT

No chemical is currently recommended for preplanting treatment nor is any one cultural procedure considered vastly superior to all others. Regardless of the preplanting methods employed, the end result should be a well-settled bed with enough loose soil on top to adequately cover the cotton seed. Existing weeds should be destroyed before or during planting.

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[1] Published with the approval of the Director of the Mississippi Agricultural Experiment Station and the Mississippi Weed Control Committee. Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Mississippi Agricultural Experiment Station.

The authors are Agronomist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, State College, Mississippi; Agronomist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, Stoneville, Mississippi; and Assistant Extension Agronomist — Cotton, Extension Service, U. S. Department of Agriculture, State College, Mississippi, respectively.

PREEMERGENCE TREATMENT

Equipment: Preemergence treatments may be made with equipment similar to that used in applying liquid insecticides. Most 1-, 2-, and 4-row planters can be modified to apply the preemergence herbicides correctly.

Planting: Following proper seedbed preparation, hill-drop the cotton seed 10 to 22 inches apart at a rate to give 4 to 7 stalks per hill. The number of seed to plant per hill will vary according to the germination percentage. Normally, 6 to 12 seed per hill will be required. If hill-dropping cannot be used then drill plant the cotton and thin at a later date.

Cross cultivation of cotton for weed control has been practiced for a number of years in adapted situations. Chemical treatment can be used in combination with cross cultivation. The seed should be drilled at a high rate (60-90 lbs. per acre).

Where preemergence herbicides are to be used the cotton seed should be covered with at least one half inch of soil. Research results have shown no advantage in preemergence weed control obtained by using a wide roller instead of the regular planter press wheel. **However, if postemergence treatments are to follow preemergence applications a wide flat press wheel will give a better shaped seedbed for the later operations and** should be used.

Placement of Herbicides: The chemical is sprayed on the soil behind the planter press wheel. The nozzle should be located to the rear of the planter press wheel or extra roller at the proper position to spray a 12-inch band centered on the drill.

Replanting: Adverse weather sometimes makes it necessary to replant cotton, including that which has received preemergence treatment. Replanting may be done in several ways. The field conditions should indicate which system of replanting to use. **Retreatment with any known preemergence herbicide, however, is not recommended.**

Preemergence Herbicides Recommended: CIPC or diuron is recommended for preemergence use on sandy loam to clay loam soils for control of most small seeded annual weeds. No preemergence herbicide is recommended for extremely sandy soils. Monuron is recommended for control of small seeded annual weeds in heavy clays such as Sharkey and Houston. No preemergence herbicides are recommended for control of perennial weeds. Both diuron and monuron are available as liquid suspensions and as wettable powders. The liquid formulations are recommended for preemergence use.

Rates of Recommended Herbicides: Recommended rates for each herbicide are presented in Table 1. Within a given soil texture the lower side of the rate-range should be used on soils low in organic matter or general fertility. In fields consisting of more than one soil type the field should either be divided into smaller fields of the same type of soil; or if the area of the secondary soil type or types is insignificant in size, the rate should be selected in accordance with the major soil type.

Preemergence Herbicides Tentatively Recommended for Small Scale Trial: Two new preemergence herbicides are tentatively recommended for control of small-seeded annual weeds in sandy loam to clay loam soils. Experiments for

Table 1.—Rates and mixing data for recommended preemergence herbicides in cotton where a 12-inch wide band is treated at the rate of 12 gallons per 13068 row feet.[1]

			Rate-lb active ingredient recommended for 13068 row-feet of 12-inch band			Pints of chemical needed for 50 gallons of spray mixture where volume of spray application is 12 gallons per 13068 row-feet of 12-inch band.[1] (Corresponds with rates presented at left)		
Herbicide	Lb. active ingredient per gallon	Soil texture	Minimum	Intermediate	Maximum	Minimum	Intermediate	Maximum
			lb.	lb.	lb.	pints	pints	pints
CIPC	4.0	Medium sandy loam	1.2	1.4	1.8	10.0	12.0	15.0
CIPC	4.0	Very fine sandy loam	1.8	2.2	2.4	15.0	18.0	20.0
CIPC	4.0	Silt loam	2.1	2.4	2.7	17.5	20.0	22.5
CIPC	4.0	Clay loam	2.4	3.0	3.6	20.0	25.0	30.0
Diuron	2.8	Medium sandy loam	.14	.17	.20	1.68	2.00	2.40
Diuron	2.8	Very fine sandy loam	.20	.25	.28	2.40	3.00	3.35
Diuron	2.8	Silt loam	.28	.34	.37	3.35	4.00	4.43
Diuron	2.8	Clay loam	.37	.42	.50	4.43	5.00	5.99
Monuron	2.8	Clay	.50	.50	.50	5.99	5.99	5.99

[1] 13068 row-feet = 1.05 acres if row width is 42 inches, 1.00 acre if width is 40 inches, 0.95 if width is 38 inches, and 0.90 acre if width is 36 inches. Calibrate sprayer to deliver 1 quart per nozzle in the same number of seconds it takes the sprayer to travel 272 feet. If this is done, the sprayer will deliver 12 gallons per 13068 row feet from each nozzle, and row width can be ignored in calibration.

Table 2.—Rates for preemergence herbicides tentatively recommended for small-scale trial in 1964.

Chemical	Rate — pounds of active ingredient needed to treat 13068 row-feet of 12-inch band.[1]			
	Soil texture			
	Medium sandy loam	Very fine sandy loam	Silt loam	Clay loam
Norea	0.30	0.42	0.55	0.75
DCPA	2.00	2.40	2.80	3.00
Prometryne	0.64	0.90	1.20	1.20

[1] 13068 row-feet = 1.05 acres ot row width is 42 inches, 1.00 acre it width is 40 inches, 0.95 acre if width is 38 inches, and 0.90 acre if width is 36 inches. Calibrate sprayer to deliver 1 quart per nozzle in the same number of seconds it takes the sprayer to travel 272 feet. If this is done the sprayer will deliver 12 gallons per 13068 row feet from each nozzle, and row width can be ignored in calibration.

the past three years indicated that neither of the two has any general or overall advantage over the two materials currently recommended. Each has provided generally satisfactory control of annual weeds, however, and all are considered safe from trial use. A brief discussion of each follows. Tentatively recommended rates were given in Table 2.

DCPA. DCPA is a highly selective herbicide and very safe on cotton. It is somewhat weak on broadleaf weed control. The rate of application is high enough to place it at an economic disadvantage as compared with other materials which are as good or better in control of weeds. It may have value where, for one reason or another, other preemergence herbicides might be hazardous to the cotton.

Norea. Norea appears very similar to diuron in its action on plants, but seems to be slightly less active. It is considered a competitive product, but the economics of its use have not been fully evaluated.

POSTEMERGENCE TREATMENTS

Cultural Treatments

Weeds in the Middles: Generally it is recommended that weeds in the middles be controlled by cultivation unless some type of broadcast herbicide treatment eliminates the need for cultivation. A new flame applicator is **tentatively recommended** for flaming row middles where control is needed and there is reason for avoiding cultivation. Plans for building the new middle flamer may be obtained from the Cotton Mechanization Project, Delta Branch Experiment Station, Stoneville, Mississippi.

Conventional cultivation and shielded cultivation: Conventional cultivation consists of the use of sweeps or other implements to throw soil into the drill area to smother young weeds and to plow up weeds growing in the middles. Shielded cultivation is similar except that shields or special implements are used to prevent movement of soil into the drill area. **Shielded cultivation should be used** if the control of weeds by previous chemical or flame treatment is completely effective, if further directed sprays are to be applied, or if immediate flaming is planned. **Conventional cultivation should be used** when neither postemergence herbicides nor flame can be used, and the control of weeds is not essentially complete.

Cross cultivation: Cross cultivation is the practice of drill-planting cotton at a heavy rate and cultivating both with and across the rows to obtain the desired stand and more effective weed control. Cross cultivation should be restricted generally to soils lighter than clays, and to relatively level fields where its use does not cause an erosion problem. Only good unbroken stands of cotton prior to cross cultivate are acceptable. The number of cotton plants left is determined by the width of the space between the sweeps, disk-hillers or other tools used in the cross cultivation. Final stands of 6 to 8 stalks per hill are satisfactory where cross cultivation is at the standard row width (38-42 inch centers). Because second and later cross cultivation may plow out additional plants, the first crossing should leave a few more plants than are needed for the final stand.

Cross cultivation can be effectively combined with pre- and post-emergence herbicides. Shield sweeps, disk-hillers, and other similar implements are recommended for the first crossing. If post-emergence naphtha is used it must be applied before the first cross cultivation. As a general rule there will be time for only one naphtha application with cross cultivation. Flame cultivation is an excellent tool to use in conjunction with cross cultivation.

Flaming: A flat type burner which uses butane, propane, or a mixture of the two is recommended. Mississippi Agricultural Experiment Station Bulletin 545 should be consulted for detailed information concerning flamers and the method of setting the burners.

As a general suggestion the grower should go to the field with the machine late in the afternoon or at night when

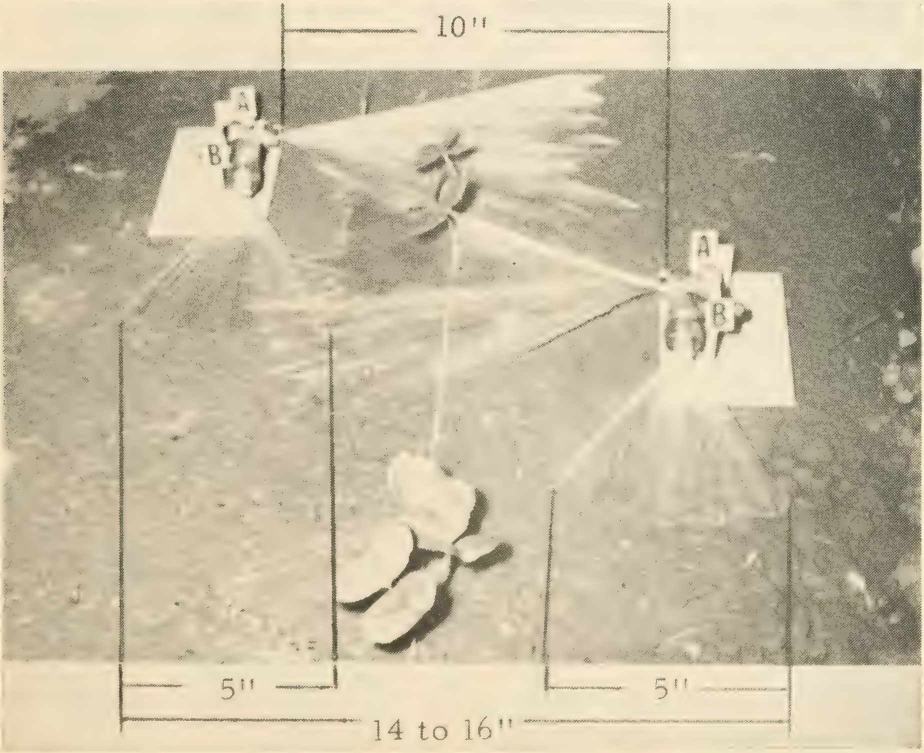

Figure 1—Nozzle setting for spraying herbicidal naphtha. Front nozzles (A) are spraying across the row, while rear nozzles (B) are spraying rearward and down. Produces 12 to 14 inches of coverage.

the flame pattern will be visible. Visibility of the pattern will make-accurate setting of the machine much easier. It is also a good idea to flame a few rows one day in advance of a general flaming. Appearance of the flamed cotton and weeds the next day may suggest changes needed to increase weed control or reduce damage to the cotton.

Flame treatments may be started when the cotton is about 10-12 inches tall and the stems are at least 3/16 inch in diameter. The field should be free of large weeds when flaming is started because flame is much more effective on small succulent weeds than on large, well established weeds. Flame should be re-applied often enough to prevent weeds from growing beyond seedling stages.

Recommended Chemical Treatments

Herbicidal Naphthas: Only naphthas which have been proved satisfactory in field tests for selective weed control in cotton should be used. No fortifying agent should be present, and these recommendations are restricted to unfortified naphthas that are sold specifically for weed control in cotton after successful field trials.

In relatively level fields where herbicidal naphthas are to be used the seedbeds should be low and flat on top after planting. **At least 16 inches centered over the drill** should be level, smooth, free of clods, press-wheel marks, and other obstructions.

Four nozzles (with fan-type orifices) per row should be used. These should be positioned as shown in Figure 1. Nozzle pair "A" should be tilted down no more than enough to keep the naphtha from settling outside the 10-inch band centered on the drill-row. This angle will normally be about 3 degrees below horizontal. Naphtha from nozzle pair "B" does not contact the cotton, and the rate of application from nozzle pair "B" should be high enough to insure good control at the edges of the treated band; this is accomplished by using orifices in nozzle pair "B" that deliver 1 ½ to 2 times as much naphtha as the orfices of nozzle pair "A". Each rear nozzle (B) should be set about 1½ inches, pointed down and toward the rear. To make certain that none of the naphtha from the "B" nozzles touches the cotton it may be desirable to also turn the "B" nozzles slightly out from the row so that the inside edge of the spray fan strikes the ground at least 3 or 4 inches from the center of the drill row.

In contoured fields (markedly sloping) it is more difficult to prepare proper seedbeds for use of herbicidal naphthas. In such cases the nozzles may be set in special ways to fit the row (See page 37 — Bul 612).

The importance of keeping the naphtha on the lowest inch of the cotton stem cannot be over-stressed. Naphtha applied high on the stem, on the bud, or on the leaves will injure or kill young cotton plants.

When the cotton seedlings have been out of the soil for 7 to 10 days (at least 2 inches tall) the first application of herbicidal naphtha may be made, if needed. The first naphtha application is needed, and should be made, when weeds make their first appearance in the treated drill area. If the cotton has been out of the soil for less than 3 weeks, from 4 to 7 gallons of naphtha per 13068 row-feet may be applied from nozzle pair "A" for the first application, depending on the amount of weed growth (13068 row-feet is equal to one acre where rows are spaced 40 inches apart). Since the naphtha from nozzle pair "B" does not contact the cotton, the rate of application is not as critical as with nozzle pair "A" (therefore calibrate nozzle pair "A" accurately and set rate of application from nozzle pair "B" by using orifices rated at 1½ to 2 times the capacity of nozzle pair "A").

Simplicity and efficiency of the first naphtha application can be greatly increased by making it **before any cultivation.** In fact two applications before cultivating may be practical if weeds in the middles are not too large.

After the cotton has been out of the ground for 3 weeks, or after the first application, no more than 5 gallons per acre should be applied at any one time from nozzle pair 'A".

Herbicidal naphtha is effective on small weeds only (less than 1 or 2 inches in height), except for nutsedge or very succulent grasses. It kills ony those weeds which it contacts. Where a preemergence herbicide has been used there may be some tendency to delay the first application of herbicidal naphtha. This is a mistake except in the comparatively few cases where control by the preemeremergence herbicide is essentially perfect. The best overall results have been obtained by establishing 100 percent control of weeds as soon as possible after emergence of the cotton.

A total of two applications, and in cases of extreme weediness even three applications, of herbicidal naphtha can be made provided certain restrictions are followed. Applications: (1) should be at least 5 days apart; (2) should be made only to cotton which is healthy; (3) should not be made when the soil is too wet to cultivate unless the air temperature is below 85 degrees; and (4) should not be made after the bark begins to form or small bark cracks begin to appear at the base of the cotton stem. Do not apply postemergence naphtha to cotton showing appreciable injury from preemergence herbicides, previous naphtha applications, hail, disease, or other factors.

Diuron: Diuron is recommended for two types of postemergence control of small-seeded annual weeds in cotton.

First, diuron at a low rate plus surfactant is recommended as a directed spray for contact control of young, actively-growing small-seeded annual weeds after the cotton is at least 6 inches tall. Diuron at a broadcast rate of 0.2 to 0.4 lb/A plus 0.5 percent surfactant appears effective and safe. A mixture of 0.2 to 0.4 pound active diuron plus 1 pint of surfactant diluted to 25 gallons with water should be used. For band spraying 2 nozzles per row, as shown in Figure 2, should be used to apply this mixture at

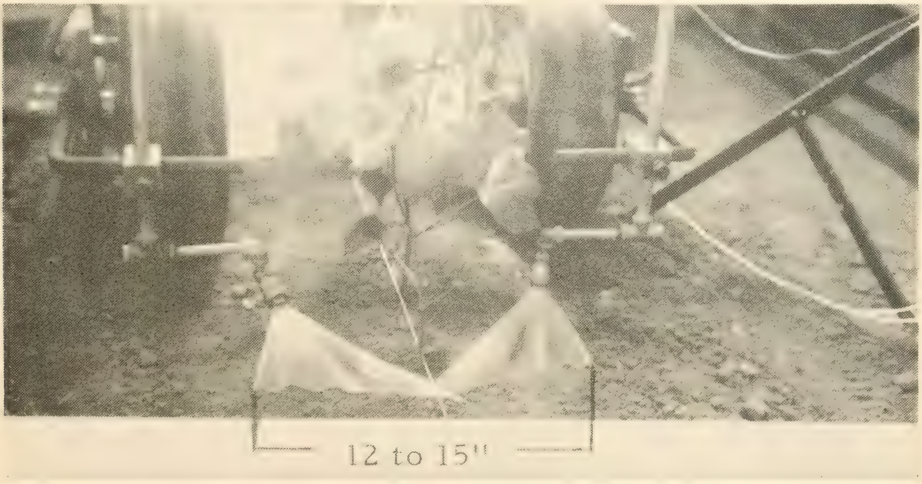

Figure 2—Down and back nozzle setting for applying aqueous mixed herbicides in a band.

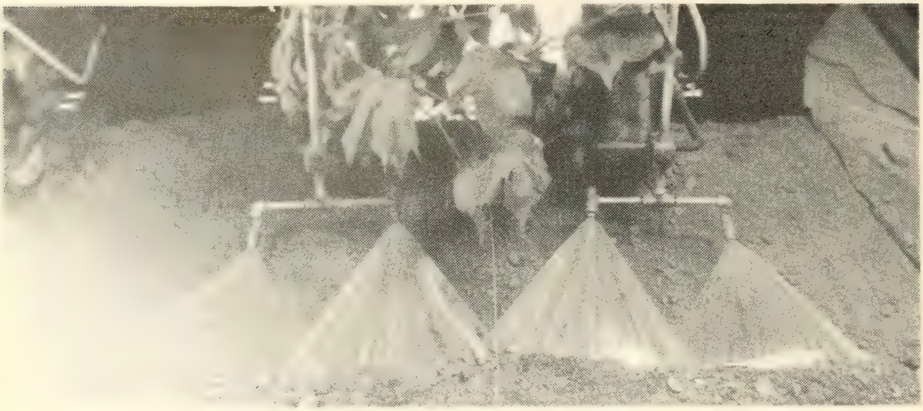

Figure 3—Four nozzle arrangement for broadcast applications.

the rate of 7.5 gallons per 13068 row feet where a 12-inch band is treated (13068 row-feet is equal to one acre where rows are spaced 40 inches apart). For broadcast spraying 4 nozzles per row, as shown in Figure 3, should be used to apply 25 gallon/A of the mixture. For best results the mixture should be applied before weeds reach a height greater than 2 inches. A second and third application may be made if necessary. Good results should not be expected if the weeds are drought-stressed at time of treatment.

Second, as a combined contact-residual spray for control of mid-and late-season small-seeded annual weeds (layby usage), diuron appears safe and effective on a qualified and restricted basis. The recommendations must be qualified because the economic value of the practice has not been established. The recommendation must be restricted to situations in which late season weeds can be expected and in which the practice can be expected to be effective. The effect of the practice of using a lay-by herbicide on the grade of hand- or machine-picked cotton has not been accurately evaluated in the Mid-South area.

Layby treatment may be accomplished by use of split applications or by a single application. Where diuron postemergence treatments are used, care must be taken to see that the total yearly rates presented in Table 3 are not exceeded regardless of whether one or several ap-

Table 3.—Rates of diuron plus surfactant for layby treatment for various soil textures.

Soil texture	Pints of surfactant per 100 gal. of spray (both types)	Lb/A of active diuron (broadcast basis)[1]		Maximum amount of active diuron recommended per year (total lb/A for all types of usage)[1]
		Split application (each time)	Single application	
Course sandy loam loamy sand or sand		Do not treat	Do not treat	0.00
Medium sandy loam	4	20 to .30	47 to .70	0.90
Very fine sandy loam	3	30 to .40	.70 to .93	1.25
Silt loam	3	40 to .60	.93 to 1.24	1.60
Clay loam	3	60 to .75	1.24 to 1.60	1.60
Clay	3	.75	1.60	1.60

[1] Because of possible hazards from residual toxicity and restrictions under Public Law 518, the total amount of diuron used per acre in one crop season should not exceed the total listed in the last column above. Therefore, where pre- or postemergence band or broadcast treatments have been used previously in the season it may be necessary to reduce layby rates to avoid exceeding the recommended yearly total.

plications are made (including pre- and postemergence band or broadcast treatments made in the early part of the season.)

Where perennial weeds such as redvine, nutsedge, and Johnsongrass are not present the split-application technique is recommended. Recommended pre- and postemergence band treatments and cultivation should be used during the initial period of the season. As soon as the cotton reaches a height of 10 inches apply a mixture of diuron plus surfactant as a directed broadcast spray (Figure 3) at the rate indicated in Table 3. Thereafter, cultivate only if weeds get out of control. Retreat at the same rate before the cotton limbs develop to the point at which they would interfere with spray application.

Nutsedge, established Johnsongrass, redvine, and other perennial weeds are not satisfactorily controlled by postemergence diuron plus surfactant. Where perennial weeds are present the split application of diuron is not recommended since cultivation and flaming should be continued well past the time at which cotton reaches a height of 10 inches. In such fields it is recommended that cultivation, postemergence band treatments, flaming, and hoeing be continued until one or two weeks before the lower limbs of the cotton develop to the point at which they would interfere with a direct-spray-application. At this time a single application of diuron and surfactant may be made as a directed broadcast spray for contact and residual control of annual weeds. The spray, as in the split-application techniques, should cover the soil evenly and not contact the cotton higher than about 2 inches up the stalk (see Table 3 for rates of application and Figure 3 for nozzle setting). Contact action of postemergence diuron appears more dependent on weather conditions before rather than after application. Small, fast growing weeds are susceptible; drought-stressed weeds are resistant. Formerly drought-stressed weeds, even large ones, became very susceptible for a period of 1 to 3 days after the initial drought-ending rain.

Residual action of postemergence diuron inhibits establishment of germinating weeds as competing plants. Soil moisture after diuron applications must reach a high level by irrigation or rainfall within 10 days after application for good residual control. Diuron wettable powder is more economical than the liquid formulation, and is satisfactory for all postemergence applications. A small amount of special preparation will have to be given to the spray equipment to insure adequate agitation of the powder.

Layby treatments with diuron should be made only where the following crop is to be **cotton, corn, or sorghum.**

Bulletin 612 (pages 16-18) should be consulted for other considerations before using layby applications of diuron.

Postemergence Herbicides Tentatively Recommended for Small Scale Trial;

Three new herbicides are tentatively recommended for contact kill of emerged weeds. All should be applied as sprays directed in such a way as to minimize contact with any part of the cotton other than the bottom one or two inches of the stem. A brief discussion of each chemical follows:

DMA. DMA, applied as a directed spray is tentatively recommended for postemergence small scale trials in cotton after cotton is at least three inches tall and until the **first bloom opens.** No more than two applications should be made, and none should be applied after the first bloom opens. A mixture of 2.50 to 3.75 pounds of active anhydrous DMA plus 1 quart of surfactant diluted to 50 gallons with water should be used. This mixture should be applied as a directed spray at the rate of 12 gallons per 13068 feet of row where a 12-inch band is treated (13068 row-feet is equal to 1 acre where rows are spaced 40 inches apart). Application as recommended here will result in application of DMA at a rate of 2 to 3 lb/A on a broadcast basis.

Nozzles should be set as in Figure 1 for cotton which is 3 to 6 inches tall. Nozzles set as in Figure 1 or as in Figure 2 may be used after the cotton reaches a height of six inches. Frequently a second treatment will be needed. In such cases the second treatment should be made 7 to 14 days after the first treatment. DMA, used as recommended here, controlled drought-stressed annual grasses and nutsedge in 1963. Single applications and dual applications at lower rates failed to provide satisfactory control in some cases.

DMA appears less effective than diuron on small actively growing weeds and more effective on large drought-stressed grasses. There is some evidence that applications of DMA alternated with diuron will provide excellent contact kill of emerged weeds. Postemergence diuron shoud not be applied, however, in cotton less than six inches tall.

Dicryl plus DMA. A mixture of dicryl pus DMA, applied as a directed spray, is tentatively recommended for postemergence small scale trials after the cotton is 3 inches tall and until the **first bloom opens.** No more than two applications per year should be made, and none should be applied after the first bloom opens. A mixture of 1 pound active DCMA and 2 pounds active anhydrous DMA diluted to 40 gallons with water should be applied as a directed spray at the rate of 12 gallons per 13068 row feet where a 12-inch band is treated (13068 row feet is equal to one acre where rows are spaced 40 inches apart).

Nozzles should be set as in Figure 1 for cotton 3 to 6 inches tall, and as in Figure 1 or as in Figure 2 for cotton more than 6 inches tall. For best results weeds should be treated before they get 2 inches tall. A second application may be used when needed. Dicryl plus DMA have given satisfactory control of young, small-seeded annual weeds, and promising results have been obtained in some experiments on nutsedge, cocklebur, and Johnsongrass.

Linuron. Linuron, applied as a directed postemergence spray, is tentatively recommended for small scale trials in cotton for control of young actively growing small-seeded annual weeds after the cotton is at least 6 inches tall. A mixture containing 0.2 to 0.4 pounds of linuron plus 1 pint of surfactant diluted to 25 gallons with water should be used. This mixture should be applied as a directed spray at the rate of 7.5 gallons per 13068 row feet where a 12-inch band is treated (13068 row feet is equal to one acre where rows are spaced 40 inches apart).

Nozzles set as in Figure 2 should be used. All instructions and limitations given previously for use of diuron at low rates as a contact postemergence herbicide apply also to linuron. Linuron is not, however, recommended at present as a layby herbicide.

SPOT TREATMENTS

Spot treatments are recommended for use in cotton where the weed infestation covers 5 percent or less of the drill area. Although this type of control is directed primarily toward control of Johnsongrass, it can be used on other weeds occurring as spot infestations. Prospective users of spot treatments are cautioned that the economics have not been thoroughly evaluated.

Naphthas, diesel fuel containing 0.25 percent PCP and dalapon solution (3.7 pounds of dalapon and 1 pint of surfactant diluted to 25 gallons with water) are recommended as spot treatment herbicides. (Dalapon is not recommended for control of broadleaf weeds.) Spot treatment should be made before the Johnsongrass or other weeds get more than 12 inches high. Retreatment should be done as needed.

BULLETIN 682 FEBRUARY 1964

Recommendations for 1964

Weed Control In Soybeans

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HENRY H. LEVECK, Director
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Nomenclature of Chemicals Used as Herbicides

This list of herbicides is intended only as an aid in obtaining the chemicals. Use of trade names does not imply endorsement of a product by the Mississippi Agricultural Experiment Station or the United States Department of Agriculture, and such names are given only for herbicides which, at the time of release of these recommendations, are marketed under the trade names listed only.

Common Name	Chemical name of active ingredient	Trade Name
Amiben	3-amino-2,5-dichlorobenzoic acid	Amiben
Dalapon	2,2-dichlorophopionic acid	Dowpon
Linuron	3-(3,4-dichlorophenyl)-1-methoxy-1-methylurea	Lorox
NPA	N-1-naphthylphahalamic acid	Alanap
herbicidal naphtha	A petroleum naphtha sold for use in soybeans	Several Mfrs
4-(2,4-DB)	4-(2,4-dichlorophenoxy) butyric acid	Butoxone SB. Butyrac 118 Butyrac 175
surfactant	Highly variable; comparative evaluation data by chemical type are very limited. Only nonionic agricultural surfactants sold specifically for use with herbicides are recommended.	Several Mfrs

CAUTION

The manufacturer's label gives the number of pounds of active material per gallon of the herbicidal concentrate, or for powders, the percentage of active ingredients. Instructions on the manufacturer's label pertaining to usage and to personal hazards in handling should be read and strictly observed.

WEED CONTROL RECOMMENDATIONS FOR SOYBEANS IN 1964

C. G. McWHORTER, V. C. HARRIS, AND J. W. McKIE[1]

The weed problem in soybeans may develop in early season, late season or progressively throughout the season. Goosegrass, crabgrass, Brachiaria, pigweed, and other small-seeded weeds usually constitute the early-season problem. Cocklebur and morningglory often develop in late season and greatly lower combine efficiency. Johnsongrass competes with soybeans throughout the growing season, lowers yields, reduces quality, and often causes substantial delays in harvesting. Since soybeans are planted in late spring or early summer, preplanting control measures may be used for Johnsongrass control that would not be suitable for use in certain other crops.

PREPLANTING METHODS OF WEED CONTROL

Johnsongrass

An application of dalapon as a postemergence foliage treatment on emerged Johnsongrass prior to planting soybeans, or repeated preplanting cultivation is recommended for the control of established Johnsongrass in fields to be planted to soybeans. Neither of these practices will provide 100 percent control nor will they control Johnsongrass seedlings which germinate after soybeans are planted. If either of these preplanting weed control practices are used a suitable preemergence herbicide should be applied after the soybeans are planted and before they emerge to aid in the control of seedling Johnsongrass to prevent reinfestation.

Combination Chemical — Minimum Cultivation Method: Dalapon should be applied at 3.7 to 5.5 lbs/A as a preplanting broadcast foliage spray to actively growing Johnsongrass at least 5 weeks prior to planting soybeans. Increased control will be obtained if a surfactant is added to the spray mixture at the rate of one-half pint of surfactant per 50 gallons of total spray. Dalapon should be applied only to areas infested with Johnsongrass. Fields with spot-infestations can be sprayed with hand or conventional tractor equipment. Johnsongrass treated with a foliage application of dalapon should be disked 4 to 7 days after herbicide application so as to remove all above-ground plant growth. If the soil is hard and packed when this disking is applied so that the soil is poorly mixed and the Johnsongrass only partly cut, the disking should be repeated. It is important that the soil be thoroughly mixed. Soybeans should not be planted until 2 ½ weeks after this disking. Johnsongrass that emerges during this period should be removed by additional disking or by cultivation with overlapping flat-sweeps before the Johnsongrass plants reach "boot" stage.

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Dalapon applied as a postemergence foliage spray to emerged Johnsongrass prior to planting soybeans will normally provide sufficient Johnsongrass control to result in increased soybean yields that will produce a larger net profit. When this treatment is used for the first time a small untreated area adjacent to the treatment area should be compared to determine the success and value of the treatment.

Dalapon applied preplanting as recommended will usually give less residual late-season control of Johnsongrass than will the intensive cultivation method described below. The use of the dalapon treatment however is not as dependent on long periods of limited rainfall for success nor does the use of dalapon tie up equipment for long periods as does the intensive cultivation method.

Cultural — Intensive Cultivation Method; Johnsongrass can also be controlled with 6 to 10 fallow-cultivations prior to planting soybeans. A disk-harrow appears to be slightly more effective than a field cultivator for Johnsongrass control. Alternate usage of the two implements is equally effective as disking alone and will be more economical than use of a disk for all cultivations. Six to 10 cultivations at 4 to 8 day intervals should be applied in a 4 to 6 week period prior to planting. If excessive rainfall prevents these treatments at uniform intervals throughout the 4 to 6 week period, disk cultivations should be applied twice to the same field on the same day and repeated whenever possible until a total of 6 to 10 cultivations are applied. The number of cultivations necessary for a given level of control will depend on the severity of the Johnsongrass infestation and the level of soil moisture present during the preplanting period. Since relatively dry soil conditions are necessary for optimum control using intensive cultivation, dalapon used as previously described will be more effective for Johnsongrass control under prolonged wet periods. Eight or 10 diskings will probably provide a longer period of good control than will the dalapon treatment but intensive cultivation requires the use of large amounts of farm machinery on a relatively strict schedule.

There does not appear to be an economic advantage from use of both dalapon and intensive fallow-cultivation preplanting. Either one or the other should be used, but not both on the same field.

Annual Weed Control

Since soybeans are planted in late spring or early summer, shallow preplanting cultivation may be used as a means of controlling one or more crops of early weeds. Very shallow disking, plowing, use of harrows or rotary hoes or tillers should destroy the weeds and form a shallow mulch. Where annual weeds such as crabgrass, Brachiaria, goosegrass, pigweed, and annual morningglory present early - season weed problems the use of herbicides may be warranted. Pre- and postemergence treatments are recommended for controlling these weeds.

PREEMERGENCE METHODS OF WEED CONTROL

Amiben is recommended for use on soils having textures of medium sandy loam to clay. NPA is recommended on soils having textures of medium sandy loam to clay loam. Linuron is a new preemergence herbicide which is recommended for use on soils having textures of medium sandy loam to clay. Rates of amiben, linuron, and NPA are presented in Table 1.

None of these herbicides should be applied preemergence to soybeans on light textured sandy soils. Regardless of the soil type the soybean seed should be covered at least one inch deep but additional protections will be obtained against possible herbicide injury if the seed are planted deeper. Soybean injury may be obtained with any of the recommended herbicides and particularly with NPA. In most instances soybean injury from these preemergence herbicides probably will not reduce crop yields if the recommended rates are applied to the proper soil type. Reduced weed control and more complete failures can be expected if the herbicides are applied to dry soil and 1 to 2 or more weeks elapse before rainfall occurs.

Amiben and linuron will generally provide better preemergence control of most weeds but especially of seedling Johnsongrass and cocklebur than NPA. If the primary weed problem is caused by cocklebur and seedling Johnsongrass the recommended rates listed in Table 1 ahould be increased 25 percent. It should be realized that even these increased preemergence rates will not provide a perfect control of weeds such as cocklebur which can germinate and emerge from a depth of 4 inches or deeper.

Table 1.—Rates of amiben, linuron, and NPA for preemergence weed control in soybeans.

	lb/A on 12-inch band[1]		
Soil texture	Amiben	Linuron	NPA
Medium sandy loams	0.6	0.3	0.6
Very fine sandy loams	0.8	0.5	0.9
Silt loams	0.9	0.6	1.2
Clay loams	1.1	0.8	1.8
Clay	1.3	1.0	.

[1] Applied only where rows are 40 inches wide.

POSTEMERGENCE METHODS OF WEED CONTROL

Cultural Methods

Conventional Cultivation of Weeds in Row Middles: This long used practice needs little explanation. It consists of the use of sweeps to throw soil into the drill area for the purpose of smothering young weeds. **It should not be used** if the control of weeds by a previous chemical is essentially complete, nor if the use of further postemergence oil is planned. If, however, oil cannot be used, and the control of weeds is not essentially complete, "Dirting cultivation" **should be used.** "Dirting cultivation," where properly used, is usually beneficial rather than detrimental to a chemical weed-control program. Failure to "dirt" or delaying "dirting" when it is needed is as detrimental to a successful program as is "dirting" when it is not needed. Care should be taken to avoid deep cultivation (which will prune the roots of the soybeans), and even shallow cultivation should be used no more often than necessary for weed control.

Rotary Hoeing: A rotary hoe may be used as soon as soybeans are up to a stand and repeated as needed at about 5-day intervals. Rotary hoeing is most effective when weeds are breaking through a slightly crusted soil but will give very little control if the soil is damp or wet. Rotary hoeing is generally a highly economical practice in terms of the weed control obtained as compared to the investment. When soybeans are in the first trifolium (one pair of true leaves) or a second trifolium leaf stage (two pair of true leaves) the rotary hoe should be used after the plants have lost some of their turgidity (slightly wilted). This usually occurs in late morning or near noon. Some weed control may be obtained from rotary hoeing soybeans in the third trifolium although weeds are generally too large and too well rooted to be effectively controlled at this stage of growth. Yield reductions may be obtained if soybeans are rotary hoed after the third trifolium is fully expanded.

Chemical Methods

Herbicidal Oils: A single directional application of herbicidal oil at 5 gallons per acre 12 to 16 days after soybean emergence and when weeds are 1 to 3 inches tall has been effective in controlling early season weeds. Under no conditions should the rate of 5 gallons per acre be exceeded or the oil applied at other stages of soybean or weed growth Only naphtha-type oils which have been proved satisfactory by research on selective weed control in cotton should be used. No fortifying agent should be present, and these recommendations are restricted to unfortified naphthas that are sold specifically for weed control in cotton after successful field research and use.

In relatively level fields where herbicial oils are to be used the seedbeds should be low and flat on top after planting. Rotary hoes should not be used prior to the application of herbicial oil since their use makes the row surface very rough. At least 16 inches centered over the drill should be level, smooth, free of clods, presswheel marks, and other obstructions.

Normally two nozzles per row are used One nozzle should be used on each side of the row and each nozzle should be 5 inches from the drill center. The two nozzles should be spaced and directed so as to prevent the two spray patterns from meeting head-on, as this might cause an objectionable deflection of the spray. Nozzles should be set so that the spray fan is horizontal and strikes the young soybean stem no higher than 1 inch from the ground level and gives adequate coverage of the weeds. The nozzles should be set so that they are 1 inch or less above the soil.

A slight downward tilt may be given to the nozzles to increase the ease of keeping oil off the soybean leaves. If the downward tilt is excessive most of the oil will be undesirably concentrated on the ground at the base of the soybean stems and the band treated will be too narrow The oil should settle in the 8 to 10-inch band centering on the drill.

Although two nozzles per row can be used successfully, the use of an additional pair set to spray the shoulder of the row will increase the ease of the operation. The additional oil needed for these two nozzles will, however, double the per acre cost of the oil. These nozzles should be set to spray parallel to the row and the pattern should extend slightly (2 — 2 ½ inches) into both the area to be cultivated and the area being sprayed by the other pair of nozzles.

The importance of keeping the oil on the lowest inch of the soybean stem cannot be over-stressed. Oil applied high on the stem, on the bud, or on the leaves will seriously injure or kill young soybean plants.

Farmers having used herbicidal oil for weed control in cotton will experience little difficulty in applying herbicidal oil to soybeans. Anyone who wants to use this practice in soybeans and does not have previous experience with oiling should proceed with caution and apply herbicidal oil only to a limited acreage the first year.

Phenoxy Herbicides: Cocklebur can be controlled in soybeans with amine salt formulations of 4-(2,4-DB). This material should be applied as a broadcast postemergence spray over the crop at a rate of 0.2 pounds per acre in a total volume of 10 to 20 gallons of water per acre. Treatments can be applied from two weeks prior to early soybean bloom until mid bloom. Best cocklebur control is obtained if 4-(2,4-DB) is applied after cocklebur plants have elongated and are equally as tall as the soybean plants or taller. This usually occurs before early soybean bloom.

Yield reductions from 4-(2,4-DB) may occur if the herbicide is applied to soybeans after early bloom that are not heavily infested with cocklebur. If cocklebur occurs in small spotted infestations throughout a field these areas should be treated on a spot basis and the herbicide not applied to cocklebur-free soybeans. Spot treatments may be made with either hand spray equipment or with a conventional tractor-mounted-boom sprayer, cutting the spray off when traveling over uninfested areas. An effort should be made to apply 4-(2,4-DB) to fields thinly infested with cocklebur at least 7 to 10 days prior to early bloom.

If soybeans are planted during the first two weeks in May, Hill soybeans will normally be expected to start blooming the first week in July, Lee soybeans the second week in July, and Jackson soybeans will normally bloom the third week in July. If Lee or Jackson soybeans are planted in the first ten days of June they will normally start blooming the first week of August.

If the cocklebur infestation is heavy and these weeds form a canopy over the soybeans the date of application of 4-(2,4-DB) is not as critical since the weeds will prevent most of the spray from reaching the soybeans. Generally as the level of cocklebur infestation increases the soybean injury obtained decreases.

Farmers who use 4-(2,4-DB) for the first time should realize that this herbicide causes injury to soybeans but injury symptoms (pronounced stem curviture, drooping leaves) generally disappear within one week after treatment. Injury is usually more severe if the chemical is applied to soybean growing in very dry soil. Little or no control of weed species such as morningglory, pigweed, and coffeebean will be obtained from the recommended rate of 4-(2,4-DB).

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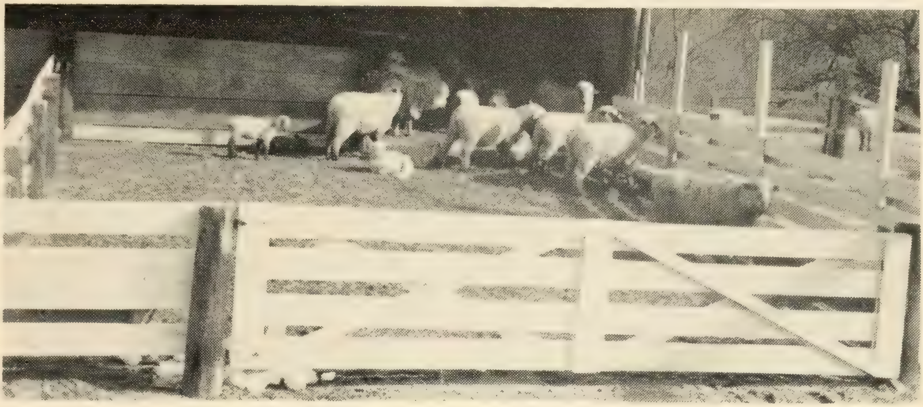

A Study Of Different Rations For Wintering Ewes

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Conclusions

The following conclusions are apparent from this two-year study involving 123 ewes and 153 lambs on 14 treatments:

1. Alfalfa hay with a supplement was the most economical method of wintering ewes and lambs.
2. Satisfactory results were obtained from both the lambs and ewes when the ewes were fed sorghum silage supplemented with either alfalfa hay or Johnsongrass hay.
3. When ewes were fed corn silage as the only roughage or when fed with ground Johnsongrass hay, the corn silage was not consumed as readily as was sorghum silage fed alone or with ground Johnsongrass hay.
4. Lambs from ewes fed sorghum silage, Johnsongrass hay and supplement had a high feed cost per pound of lamb average daily gain.
5. Feeding ewes ground Johnsongrass hay plus a supplement resulted in a high ewe feed cost per pound of lamb produced.
6. Ewes allowed to graze winter pasture had, on an average, the highest ewe feed cost per pound of lamb average daily gain.

A Study of Different Rations for Wintering Ewes

By H. W. ESSIG, R. A. EDGAR AND C. J. CHRISTIANS

Numerous feed supplement trials have confirmed the early results of Barnicoat and associates (1) who reported that nutrition during lactation was of more importance in determining milk yield of ewes than nutrition during late pregnancy. The duration of lactation was greatly reduced in tests conducted by Palsson and Verges (2) when the ewes were fed on a low plane of nutrition during gestation and lactation. Hugo (3) reported that Merino ewes fed on a high plane of nutrition during gestation and lactation gave 81% more milk than ewes on a low plane of nutrition during these periods. According to the Recommended Nutrient Allowance for Sheep by Nutrition Research Council (4), "Probably the most common nutritional deficiency of sheep is lack of energy. This may result from lack of sufficient total feed or from the intake of such low digestible energy in the feed that the animal is unable to obtain enough useful energy from the feed to meet its requirement. Poor roughage, in abundance, will often not supply enough TDN for sheep." According to Morrison (5), "Ewes that are suckling lambs need a liberal supply of TDN. Therefore, ewes lambing before they go to pasture need a sufficient amount of concentrates, in addition to good roughage, to keep up a good milk yield. If they are on suitable pasture they need to be fed no concentrates." Workers at Purdue (6, 7, 8) have shown that oat straw supplemented with protein was not adequate for wintering ewes. However, corn silage properly supplemented or alfalfa hay gave favorable results.

It is the common practice in Mississippi to winter ewes and fatten their lambs on winter pasture; however, a period of lack of forage generally appears at some point between December 1 and March 1 Therefore, the objectives of the studies reported here were to study types of roughages and concentrates or combinations of the two which would best supplement or replace the presently accepted method of wintering ewes and lambs.

Trial I, 1959-60

Experimental Procedure; Trial 1 was conducted to determine the type and amounts of roughages and concentrates which would be efficient in supplementing the ewe wintering and lamb fattening regimes. Sixty-six western crossbred ewes with their lambs were divided into six groups on the basis of date of lambing and number of lambs. The rations fed are shown in Table 1. Rations 1 through 5 were composed of roughage (hay and/or silage) plus a supplement, whereas ration 6 consisted only of sod-seeded oats. The grain supplement fed to the ewes in the drylot treatments consisted of 40% ground corn, 40% crimped oats, and 20% cottonseed meal. Ewes in treatment 6 were allowed to graze the sod-seeded oats from about 8:30 a.m. until 4:00 p.m. each day. All ewes and lambs had access to a mineral mixture containing two parts trace mineralized salt and one part steamed bone meal. All lambs had access to a creep which was of the same composition as the grain supplement fed the ewes.

Table 1.—Feed consumption, calculated analysis and daily requirements.

Treatment	1	2	3	4	5	6
Ave. daily consumption per ewe						
Alfalfa hay	-- ----	1.50	-- ----	-- --	2.64	-- --
Silage, sorghum	4.49	5.82	7.40	-- ----	-- ----	-- --
Supplement[1]	1.50	0.75	1.50	1.50	0.50	-- --
Johnsongrass hay	1.35	-- ----	-- ----	1.51	-- ----	-- ----
Pasture (sod-seeded oat)	-- ----	-- ----	-- ----	-- ----	-- ----	+
Total consumption per day per ewe	7.34	8.07	8.90	3.01	3.14	Unknown
Total daily feed cost per ewe, ¢	7.291	6.499	6.476	6.144	6.039	7.58[2]
Calculated analysis						
Total digestible nutrients	2.45	2.13	2.22	1.86	1.59	-- --
Crude protein	0.40	0.41	0.36	0.34	1.14	-- --
Dry matter	3.68	3.49	3.22	2.70	2.80	-- --
Total nutrient's	6.53	6.03	5.80	4.90	5.53	-- --
Ration laking in following nutrient's						
Total digestible nutrients	—0.12	—0.37	—0.28	—0.64	—1.41	-- --
Crude protein	+0.07	+0.10	+0.03	+0.01	+0.81	-- --
Dry matter	—0.05	—0.31	—0.58	—1.10	—1.00	-- --
Ewe Requirements (Morrison's)						
Total digestible nutrients	2.5 — 2.90					
Crude protein	0.3 — 0.33					
Dry matter	3.8 — 4.50					

[1] The supplement contained 40% cracked corn; 40% crimped oats; and 20% CSM. Ingredient costs were priced as follows: corn $1.35 per bu.; oats $.94 per bu.; CSM $67 per ton; sorghum silage $6 per ton; Johnsongrass hay $25 per ton; alfalfa hay $35 per ton; and sod-seeded oats $25 per acre.

[2] Cost was based on grazing stocking rate of 2 ewes and lambs per acre for about one-half of the grazing period.

This trial began December 15, 1959 and ended March 1, 1960. Ewes and lambs were weighed at the start, at 14-day intervals and at the end of the wintering period. Records were kept on all feed consumed by the ewes. No record was kept on the feed consumed by the lambs.

Results and Discussion: Table 1 shows the feed consumption, calculated analysis and daily requirements for the ewes. Calculations showed that all rations were lacking in total digestible nutrients (TDN) and dry matter (DM) and were high in crude protein, according to Morrison's requirements.

The sorghum silage-Johnsongrass hay ration (treatment 1) was the most nearly balanced but was still below the recommended level by 0.12 lb. in TDN and 0.05 lb. in DM, whereas the crude protein level was 0.07 lb. above the allowance. Each ewe on this ration lost about 4.75 lbs. which was near the average weight loss for the ewes in drylot while the ewe feed cost per pound of lamb average daily gain was almost the highest.

The sorghum silage-alfalfa hay ration (treatment 2) exhibited the least amount of weight loss in the ewes whereas the lambs of these ewes produced gains which could only be considered average for this trial. The sorghum silage ration fed in treatment 3 contained 0.03 lb. excess crude protein and was deficient in TDN and DM. Ewes on this treatment rooted a large amount of the silage out of the feed trough and this feed was charged to them, perhaps explaining why they did not perform as well as ewes on other tratments.

Treatment 4 (Johnsongrass hay ration) contained the least amount of excess protein (0.01 lb.), the largest amount of dry matter deficit and the second greatest amount of TDN deficit. Ewes fed this ration exhibited an average weight loss and average lamb gain. This was probably due to the calculated nutrient values being too high for the Johnsongrass hay. The ration fed in treatment 5 (alfalfa hay) was the least balanced of the five rations, according to calculations, due to the lack of TDN and DM and having an excess of protein. It produced second highest gain in the lambs and second smallest loss in ewe weight.

Ewes on treatment 6, wintered on sod-seeded oats and fed no other source of feed, showed the greatest ewe weight loss with the lambs having the largest average daily gain.

Results of this study are shown in Table 2. Of the 66 ewes that started the test, 61 finished. Four were removed because of death of their lambs and the fifth because of a broken neck. All ewes in the trial lost weight, which can be explained by the fact that all rations were low in TDN. The most significant ewe weight loss occurred in lot 6 (winter grazing) where the ewes average daily loss was 0.21 pounds. The probable principle reason for this was that the ewes were lactating and apparently did not receive a sufficient amount of nutrients from the winter grazing to meet the minimum requirements. The ewes losing the least amount of weight per day were on treatment 2 (alfalfa hay, silage, and supplement) losing only 0.03 pound per day.

Eight-four lambs started the test; however, six were removed before the end of the test—five because of death and one because of the death of a ewe. The average initial weight of the lambs was approximately 17 lbs. The lambs exhibiting the highest average daily gain were on the sod-seeded oat treatment (0.51 lb.). Those with the lowest average daily gain (0.38 lb.) were on the sorghum silage ration (Treatment 3) and the ewes on this treatment showed the second greatest loss of weight.

The total daily feed cost per ewe was greatest for the ewes allowed to graze sod-seeded oats. In the treatments where the ewes were fed in drylot the daily feed cost per ewe was only slightly less than that for ewes on sod-seeded oats. Ewe feed cost per pound of lamb average daily gain for the alfalfa hay supplement treatment was about two cents per pound less than that for the remaining treatments. Treatments 1 and 3 (those containing silage) showed the highest ewe feed costs per pound of lamb average daily gain.

Summary Trial I: The ration consisting of 2.64 pounds of alfalfa hay and 0.50 pound of supplement (Treatment 5) was the least expensive to feed per day per ewe. Cost of lamb production from ewes fed this ration was the least when based on the ewe feed cost per pound of lamb average daily gain. Most expensive rations in this trial were sorghum silage and supplement (treatment 1) and sor-

Table 2.—Gain or loss of ewes and lambs (75 days), Trial 1.

Treatment	1	2	3	4	5	6
EWES						
Number to start	11	11	11	11	11	11
Number to finish	11	8[1]	10[1]	10[2]	11	11
Ave. initial weight	125.6	121.0	122.4	122.6	123.8	122.0
Ave. final weight	120.9	118.5	114.7	116.3	117.0	106.2
Ave. daily loss	0.06	0.03	0.10	0.08	0.06	0.21
Ave. total loss	4.73	2.50	7.65	6.30	4.82	15.80
LAMBS						
Number to start	14	14	14	14	14	14
Number to finish	14	10	13	13	14	14
Number of animal days	1050	750	975	975	1050	1050
Ave. initial weight	18.1	17.4	18.2	16.9	17.3	16.1
Ave. final weight	50.9	51.7	46.9	49.0	53.6	54.2
Ave. daily gain	0.438	0.457	0.384	0.437	0.484	0.508
Ewe feed cost per lf. lamb ADG	16.65	14.22	16.86	14.06	12.48	14.92

[1] Ewes removed due to death of their lambs.

[2] Ewe broke neck.

ghum silage-Johnsongrass hay and supplement (treatment 3). When sorghum silage, alfalfa hay and supplement were fed, good results were obtained. When the treatments (rations) in this trial are ranked on the basis of least cost and best performance they are: 5, 4, 2, 6, 1 and 3.

Trial II, 1962-63

Experimental Procedure: Trial 1 had shown that the alfalfa hay ration produced economical lamb gain but further information on other roughage combinations fed at levels to meet the nutritive requirement of the ewe was needed. Therefore, trial 2 was initiated to study the value of roughages such as sorghum silage, corn silage, Johnsongrass hay, alfalfa hay and winter pasture for wintering ewes prior to lambing and after lambing.

Trial 2 was conducted during the '62-'63 wintering period from November 14 to February 22. Eighty ewes were randomly divided into eight groups; however, only 62 of the ewes lambed while on experiment and only they were used in the study. One group was then assigned to each of the treatments shown in Table 3.

All treatments except 4 and 5 were fed in drylot. Sheep on treatments 4 and 5 were allowed to graze a mixture of oat and ryegrass. All lambs had access to a creep ration which contained 45% crimped oats, 45% cracked corn and 10% cottonseed meal. All ewes and lambs had access to a mineral mixture which contained one part deflourinated rock phosphate, one part limestone and two parts trace mineralized salt. Wood shavings were used as bedding. The supplement mixtures were calculated to provide equal crude protein and total digestible nutrients if the roughage consumption was at the estimated level. The criteria for evaluating the rations were ewe weight change, ewe condition score, ewe wintering cost, and average daily gain and grade of lambs.

Results and Discussion: Rations used in this trial were calculated to furnish 0.42 lb. crude protein and 2.9 lbs. TDN, provided consumption was at the estimated level of intake shown in Table 3. When the feed consumption was determined, the ewes on treatment 1 and 8 were below the estimated intake level (Table 4). The lowered feed intake by ewes on these two treatments was probably due to the lack of acceptance of the corn silage, thereby resulting in the lowest daily feed costs per ewe. Feed consumption records also showed that the ewes in treatment 6 (ground Johnsongrass hay) consumed more feed than the estimated intake; however, it should be pointed out that the ewes in this treatment rooted a great deal of feed out of the feed trough. This waste resulted in the highest feed cost per day for ewes fed in drylot. The feed cost for all treatments was highest for the ewes on winter pasture (treatments 4 and 5). Perhaps one reason for this was the unusually severe winter which slowed forage growth and limited the number of animals allowed to graze per acre.

All ewes lost weight and all showed a reduction in condition score. Those on treatment 7 (sorghum silage and alfalfa hay) showed the least average daily loss

Table 3.—Ration composition necessary to furnish 0.42 lb. C. P. and 2.9 lb. TDN daily.

Treatment	1	2	3	4	5	6	7	8
Pasture (Oat-Ryegrass)	--	--	--	+	+	--	--	--
Corn Silage	7.0	--	--	--	--	--	--	4.5
Sorghum Silage	--	7.0	4.5	--	--	--	5 75	--
Ground Johnsongrass Hay	--	--	1.5	--	--	2.0	--	1.5
Alfalfa Hay	--	--	--	--	--	--	1.5	--
Supplement	2.5	2.25	2.0	--	--	2.55	1.65	1.8

Table 4.—Ewe performance on various winter rations in trial 2 1962-63.

Treatment	1	2	3	4	5	6	7	8
Ewes								
Number ewes	9	7	7	8	9	7	6	9
Av. initial wt.	134.8	130.1	129.6	121.5	129.9	130.3	128.8	135.7
Av. final wt.	110.2	118.4	110.6	108.9	110.2	116.9	120.0	111.1
Av. daily loss	0.246	0.117	0.190	0.126	0.197	0.134	0.088	0.246
Av. initial condition score[1]	6.40	3.86	3.86	4.13	3.89	4.57	4.75	3.72
Av. final condition score	2.60	2.57	2.50	2.19	1.94	2.36	2.75	1.78
Av. condition score change	3.80	1.29	1.36	1.94	1.95	2.21	2.00	1.94
Daily feed consumption:	7.57	9.86	7.99	-----	-----	5.40	8.60	7.18
Pasture[2]	-----	-----	-----	+	+	-----	-----	-----
Corn silage	5.61	-----	-----	-----	-----	-----	-----	4.11
Sorghum silage	-----	7.16	4.53	-----	-----	-----	5.41	-----
Ground Johnsongrass hay	-----	-----	1.45	-----	-----	2.37	-----	1.36
Alfalfa hay	-----	-----	-----	-----	-----	-----	1.55	-----
Supplement	1.96	2.70	2.01	-----	-----	3.03	1.64	1.71
Supplement percent composition								
Corn	75	75	45	--	--	65	96	45
Oats	13	13	43	—	--	27	---	43
CSM	10	10	10	-	—	6	—	10
DFRP	2	2	2	—	—	2	4	2
Vit. A, 2,500 I.U./lb. supp.	+	+	+	--	---	+	+	+
Supplement cost per lb., ¢[3]	2.62	2.62	2.77	-----	-----	2.65	2.47	2.77
Total daily feed cost per ewe, ¢[3]	6.818	9.222	6.927	13.33	13.33	11.585	8.387	6.300

[1] Condition score was based on a 9 point scale which contained three major condition classifications: Thin, 2; Average, 5; Fat, 8; with each major classification having three possible values (i.e. low average, 4; average, 5; high average, 6).

[2] Pasture was used during the entire wintering and a pasture cost was estimated to be $40 per acre. The wintering grazing stocking rate was 1.5 ewes with lambs per acre and was grazed for 100 days or approximately ½ of the available grazing period.

[3] Cost of ingredients: Corn, $1.36 per bu.; Oats $.94 per bu.; Cottonseed meal $67 per ton; Deflourinated rock phosphate $2.80 per 100 lb.; Vitamin A 10¢ per million I.U.; Alfalfa hay $35 per ton; Johnsongrass hay $25 per ton plus $5 per ton for grinding; corn and sorghum silage $6 per ton.

while those receiving treatments 1 and 8 (rations containing corn silage) had the greatest loss. The loss by ewes in the various treatments was not considered to be critical since the initial weight was taken before the ewes lambed. If one would assume that each ewe lost about 10 pounds due to lambing this would constitute about one-half or more of the ewe weight loss.

There was little difference in average daily gains between the lambs from ewes on treatments 2, 7, and 8 (Table 5). These lambs gained about 0.10 lb. more than those from treatments 1, 3, 4, 5, and 6. Based on pounds of lamb gain per ewe per day of lamb age (takes into account twins) there was considerably less advantage for the lambs from ewes on treatments 2, 7, and 8 when compared to those on treatments 1, 3, 4, 5 and 6. The calculations of feed cost per pound of lamb average daily gain (A.D.G.) and feed cost per pound of lamb gain per ewe per day showed similar trends. Lambs from treatment 8 produced the most economical gain when calculated on the basis of feed cost per pound of lamb average daily gain or on the basis of feed cost per pound of lamb gain per ewe per day of lamb age. The lambs from ewes on treatments 4, 5, and 6 were produced at the greatest cost per pound. There was little difference between cost of gains of lambs from ewes on treatments 1, 2, 3 and 7.

Summary Trial 2: In trial 2 the ration consisting of sorghum silage, ground Johnsongrass hay and supplement produced the most economical ewe feed

Table 5.—Lamb performance trial 2 1962-63.

Treatment	1	2	3	4	5	6	7	8
Lambs:								
Number	12	8	9	10	12	9	6	9
Birth wt.	8.02	8.10	7.48	7.84	8.28	6.97	8.42	7.76
Final wt.	24.9	34.9	26.6	29.3	32.1	25.7	37.17	36.0
Ave. gain	16.9	26.78	19.07	21.46	23.81	17.92	28.75	28.2
Ave. daily gain	0.299	0.430	0.310	0.316	0.3.70	0.298	0.419	0.423
Animal days	679	498	554	680	772	541	412	601
Ave. lamb age	56.5	62.3	61.6	68.0	64.3	60.1	68.7	66.8
Total gain	202.8	214.2	171.7	214.6	285.7	161.3	172.5	254.2
Grade[1]	10.3	12.3	10.28	10.55	10.46	10.56	11.8	10.61
No. sets twins, weaned	3	1	2	2	3	2	0	0
No. sets twins, born	3	1	2	2	3	3	1	2
Lb. of lamb gain per ewe per day lamb age	0.399	0.491	0.398	0.394	0.494	0.383	0.419	0.423
Ewe feed cost per lb. lamb ADG	22.80	21.45	22.35	42.18	36.03	38.86	20.02	14.89
Ewe feed cost per lb. lamb per ewe	17.09	18.78	17.40	33.83	26.98	30.25	20.02	14.89

[1]Feeder grades were scored: low good — 9; good — 10; high good — 11; low choice —12: choice — 13.

cost per pound of lamb average daily gain and daily feed cost per ewe. There was little difference in the ewe feed cost per pound of lamb average daily gain for treaments 7, 2, 3, and 1, while treatments 4, 5, and 6 were distinctly more costly than the other 5. When the rations in this trial were ranked on the basis of least cost and best performance they were: 8, 7, 2, 3, 1 6, and 4, and 5

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The Relationship of Local Egg Marketing Programs to the Demand For Eggs

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ON THE COVER: Government inspector at work in an egg grading plant.

THE RELATIONSHIP OF LOCAL EGG MARKETING PROGRAMS TO THE DEMAND FOR EGGS

BY DOROTHY DICKINS AND ALVIRDA F. JOHNSTON

Receipts from the sale of eggs is an important source of income for Mississippi farmers. Production of eggs is increasing in Mississippi, but per capita consumption in the United States is falling. High consumption of this nutritious food is important to the family as well as to the farmer. Better market facilities and better eggs offer possibilities for increasing egg consumption.

With the purpose of raising the quality of the eggs sold in Mississippi, of instructing producers and distributors in methods of keeping the quality high, and of increasing egg production in the state, laws were passed in 1956 setting standards and providing for inspectors with regulatory and educational duties. Inspection service began in 1957.

According to an egg survey made by the Mississippi Department of Agriculture and Commerce in April-June, 1961, at the time this study was started, there were 257 independent producers or agencies with 523 additional contract growers involved with a total of 3,165,823 hens and pullets of laying age on hand. There were one or more commercial egg producers in every county of the State.

It is the purpose of this study to determine (1) **from representative families:** (a) sources of purchase of eggs; (b) grades, prices, amounts, and uses of purchased eggs; (c) beliefs and attitudes regarding eggs and increased use; (d) sources and kinds of information used in purchasing eggs; **and** (2) **from representative merchants:** (a) prices and volume of different types of eggs handled; (b) method of handling; and (c) changes noticed since inspection service has been in operation.

An analysis of data from these interviews with homemakers and merchants would serve as a basis for evaluation of local egg marketing programs such as are now in operation. It would likewise serve as a basis for planning programs with farmers and consumers.

Scope and Methods

Data were obtained during the winter of 1961-62 and the spring of 1962[1] by personal interview with a representative sample of approximately 125 families in each of ten towns (Marks, Batesville, Picayune, Ellisville, Waynesboro, Lexington, Belzoni, New Albany, Booneville, and Bay St. Louis[2]; and of approximately 125 families in each of four villages (Eupora, Ackerman, Calhoun City, and Bruce). Since town and village maps were not available, samples in each town and village were taken by random selection of household users of electricity, except in Booneville. Here the sample was taken from a list of families with water meters.

Only families whose members usually had one meal per day in the home together were included. Families who usually ate one meal at home together but who happened to be away from home the week preceding the interview were revisited later to get a record for a typical period. Institutional families (those with 5 or more boarders) and families of one person eating at home alone were not included. These families are relatively unimportant from the consumer market viewpoint.

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[1] A few families were interviewed in November 1961 and in June 1962.

[2] From 2500 to 7800 population.

There were 2033 families in the sample. One hundred and sixty-five of these were ineligible and 88 could not be contacted or were unable to participate. Only 24 refused to cooperate. Of the 1756 families with whom schedules were completed, 1284 were white families, 471 Negro families and one a Chinese family. Twelve hundred and fifty-four of the families lived in towns and 502 lived in villages. Seven hundred and fifty families were interviewed in winter and 1006 in spring.

Originally it was planned to select for the study towns where USDA inspectors' records showed a relatively high as well as a relatively low percentage of eggs from local egg marketing programs. However, after careful consideration it was decided to limit the study to small towns and villages where more change had perhaps taken place.

The inspectors' records on violations of producers could not be used as a measure of rejected eggs since education had to precede strict enforcement. Often violations by local or state producers are handled by advising or reprimanding the producers rather than by stopping sales. For example, if the inspector found dirty eggs labeled as grade A, he would ask the producer to pick up the eggs. According to present policy, eighty percent of the inspector's time is allotted to public relations (i.e. education with producers and merchants). A larger percentage of time was so used when the program began.

The Families

Homemakers were asked to check the income group (before deduction) which most nearly fitted that of their family during the past year. Income was defined as the sum of gross amounts in wages, salaries, bonuses, and commissions of all family members, receipts from farm or business operation minus farm or business expenses, and other income such as pensions, veterans payments, unemployment insurance, net from rental property, interest from bonds, etc. About one half the families had incomes of less than $4,000; about one half, $4,000 and over, as is shown.

Income past year	**Percentage of families**
Less than $2,000	27
$2,000 — $3,999	28
$4,000 — $5,999	26
$6,000 and over	19

Three percent of the families had lived less than one year in the town or village in which they resided. Thirty-one percent had lived there 1 — 9 years; 38 percent, 10 — 24 years; 28 percent, 25 years and over. This means that the majority of families had resided in the town or village before egg marketing programs were in operation.

Family size was estimated on the basis of the number of meals served from the home supply during the past week, 21 meals being counted as one member. Figured on this basis, 8 percent of the families had less than 2 members; 57 percent, 2 — 3.99 members; 26 percent 4 — 5.99 members; and 9 percent, 6 members or more.

During the week preceding the interview families had spent the following amounts for food per person per meal to be used at home and for packing lunches.

Amount spent for food per person per meal	Percent of families
Less than 10¢	6
10¢ - 19¢	26
20¢ - 29¢	33
30¢ - 39¢	20
40¢ - 49¢	10
50¢ - 59¢	3
60¢ or more	2

There was a highly significant relationship between expenditures for food and family income. Eighty percent of the families spending less than 10c per person per meal had incomes of less than $2,000.[3] Fifty-four percent of the families spending 60c or more per person per meal had incomes of $6,000 and over.

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[3] Included families getting practically all foods as gifts.

The most typical type of family was one of adults only (36 percent). Next in importance was a family with adults and all children 13 years and under (35 percent). In 12 percent of the families all children were from 6 — 19 years; in 12 percent all were 14 years and over. In 5 percent of the families the ages of children ranged from pre-school through 19 years.

Sixty-five percent of the homemakers spent no time away from home each week because of work. Twenty-one per cent spent 40 hours or more at work including travel time and 14 percent spent 39 hours or less. Ages of homemakers were fairly evenly distributed among all age groups, as is shown:

Age Group	Percentage
29 years & under	17
30 - 39 years	23
40 - 49 years	24
50 - 59 years	18
60 years & over	18

Fifty-one percent of the homemakers had completed high school or had one or more years in college; thirty percent had finished high school; and 21 percent had one or more years of college training. Twenty-one percent had finished from 5 — 8 grades and the same percentage 9 — 11 grades. Only 6 percent had less than 5 grades of schooling. One percent had attended ungraded schools, or gave no report on schooling.

Grocery Stores

Data concerning eggs were obtained by interviews with owners or managers of 171 grocery stores, from 41 in 4 villages and from 130 in the 10 towns.

Sixty-two percent of the village merchants and 52 percent of the town merchants said they sold more eggs in the fall and winter than in the spring and summer. Only 5 percent of the village merchants and 9 percent of the town merchants stated spring and summer as the season most eggs were sold. Some of these were mentioned in connection with summer tourist trade. Greater sale of eggs during fall and winter is no doubt related to the fact that this is the season home flocks are not laying. Thirteen percent of the village merchants and 23 percent of the town merchants mentioned holidays in connection with the time of year they sell the most eggs. The holidays frequently referred to in connection with eggs were Easter and Christmas.

When asked at what time of the year they received the most customer complaints about eggs, 64 percent of the village merchants and 80 percent of the town merchants replied, "Don't receive complaints". Thirty-two percent of the merchants in villages and 15 percent of those in towns replied, "Spring and summer." The remaining answered, "No particular time."

About one half of both village and town merchants stated that in the past two years they had received fewer complaints about eggs than they received before that time. Twenty percent of the village and 41 percent of the town merchants stated they saw no difference. The others said they had been in business a short time only, or gave no reply.

One half of the merchants, both village and town, made favorable or very favorable comments about the eggs available since inspection. Some of these comments were "Egg inspection has cut complaints to none"; "Since egg inspection I have had no complaints"; 'Good thing ungraded country eggs are almost of the past"; "Used to have lots of trouble with country eggs, no desire to go back to old way of buying"; "The merchant and customer are both getting a good deal from the egg program"; "Too much trouble before egg program"; "In summer sometimes found 5 or 6 bad eggs in a dozen"; "Remember when half of them would be rotten. I stopped buying them when graded eggs came in"; "Couldn't find good quality eggs before egg program."

Seventy-five of the grocery stores were visited in winter; 96 in the spring. Little or no difference, however, was found in frequency of deliveries by those interviewed at different seasons. Thirty-one percent of the 171 had egg deliveries twice weekly, 26 percent once weekly, 25 percent as needed or when called, and 18 percent 3 or more times a week.

Ninety-five of the 171 groceries kept all or part of their eggs refrigerated. These eggs were most often refrigerated at temperatures of 35° — 40° F. (temperatures were taken by Mrs. Johnston who visited each grocery store.[4]) At both periods of interview about two-thirds of the merchants had 30 dozen eggs or less on hand.

The time of the last delivery of eggs for about one half of the stores (49 percent in stores visited in winter; 57 percent in spring) was "today" or "yesterday". The time of the last delivery of eggs was "over 3 days ago" for only 17 percent of the merchants contacted in spring and 29 percent contacted in winter.

Kind of Eggs Handled in 171 Groceries

Table 1 shows properties of grades AA, A, and B eggs according to Mississippi shell egg law based on USDA grades.

It was found that the sale of ungraded eggs (those not classified into grades) was more common in villages than in towns. In fact, there was a highly significant relationship between kind of eggs handled and location of store (Table 2).

At the time of the study only 14 of the 171 stores had eggs on hand that had been shipped in from out of the state. However, 16 stores in towns and two in villages reported they used such eggs.

Table 3 shows type of producers from whom village and town merchants purchased eggs.

Local egg marketing programs by the State Department of Agriculture have as their objective improving the quality of eggs and in turn increasing egg consumption. They work with commercial pro-

Table 1. Properties of grades AA, A, and B eggs.*

Quality Factor	AA Quality	A Quality	B Quality
Shell	Clean, unbroken, practically normal	Clean, unbroken, practically normal	Slight soiled areas, unbroken, may be slightly abnormal
Air Cell	1/8 inch or less in depth, practically regular	2/8 inch or less in depth, practically regular, clear	3/8 inch or less in depth, may show unlimited movement, and may be free but not bubbly
White	Clear, firm	May be reasonably firm	Clear, may be slightly weak
Yolk	Well centered outline, slightly defined, free from defects	May be fairly well centered, outline may be fairly well defined, practically free from defects	May be off center, outline may be well defined, may be slightly enlarged and flattened, definite but not serious defect

*No grade C eggs are sold in stores of the state.

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[4] In visits to grocery stores Mrs. Johnston always carried along a thermometer which she used when the store refrigerator had none.

Table 2. Grades of eggs on hand at time of survey in stores of villages and towns.

Grade of eggs on hand	Village Groceries	Town Groceries*
	Percent	Percent
Grade A only	27	59
Grade A & ungraded	39	18
Ungraded only	34	21
Total No.	41	130

*One store sold both grades A and B and two stores gave no report. In other words eggs handled were either Grade A or ungraded eggs.

Table 3. Type of producer from whom village and town merchants purchased eggs.

Type producer	Village Groceries	Town Groceries
	Percent	Percent
Mississippi commercial	34	64
Mississippi commercial & hatchery	0	2
Mississippi commercial, hatchery & local farm	0	1
Mississippi commercial & local farm	39	12
Hatchery only	0	2
Shipped commercial only	0	6
Shipped commercial & Mississippi commercial	0	4
Local farm only	27	8
Hatchery and local farm	0	1
Total No.	41	130

ducers showing them how to grade and size their eggs. They check eggs in stores to see if product is correctly labeled as to grade. Not all commercial producers grade eggs. In other words, some of these are sold as ungraded eggs, as are hatchery eggs.

Merchants in towns depend much less on eggs from the local farm, i.e. "bucket eggs", and more often sell graded eggs. This may in large part be related to the fact that many of these small local farm owners are regular customers as well as friends of the grocer. The grocery owner buys the eggs to promote and continue good will.

Table 4 shows amount of eggs sold per week in grocery stores. As will be noted, relatively more town grocers sold over 150 dozen eggs each week. In fact, there was a significant relationship between the amount sold and location of store.

A comparison of the practice of selling eggs in cartons in village and town groceries is shown in Table 5.

About one fifth of both village and town groceries using cartons had all or part of the cartons dated.

All types of eggs, i.e. grade A large, ungraded mixed, grade A medium, etc., usually sold for less than 50 cents a dozen in spring and for more than 50 cents a dozen in winter.

The sale of ungraded eggs was much more common in spring (Table 6). In fact, there was a highly significant relationship between kind of eggs sold and season. Many more of the ungraded eggs were sold in spring when local farmers'

Table 4. Amount of eggs sold weekly in village and town grocery stores.

Amount sold weekly	Village Groceries	Town Groceries
	Percent	Percent
30 dozen or less	29	30
30 - 60 dozen	22	19
61 -150 dozen	37	18
151 dozen and over	12	33
Total No.	41	130

Table 5. A comparison of the practice of selling eggs in cartons in village and town groceries.

Practice	Village Groceries	Town Groceries
	Percent	Percent
All eggs in cartons	32	60
No eggs in cartons	29	25
Part of eggs in cartons	39	15
Total No.	41	130

Table 6. Grades of eggs on hand in groceries at time of survey, winter and spring.

Grade of eggs on hand	In winter*	In spring*
	Percent	Percent
Grade A only	69	37
Grade A & ungraded	14	31
Ungraded only	16	30
Total No.	75	96

*One sold both grade A and B.
**Two gave no report.

eggs were available.

Table 7 shows that more local farm eggs are sold in spring than in winter. This is the season in which they are available in large quantities. In winter when there is a limited supply, merchants depend more on commercial producers.

Homemakers interviewed in the 10 towns and 4 villages were asked; "If you ever buy eggs, what do you think of the quality and kind of eggs offered for sale in this town or village?" Ninety percent of the women interviewed said the eggs in this town are good, o.k., satisfactory. In other words, most homemakers were pleased. Only one in ten gave qualified replies or indicated dissatisfaction. Typical of these replies were: good, if graded; good, if from a certain producer; some good, some poor; good, if brown or country. There was a highly significant relationship between quality of eggs sold and locations of stores.[5]

Importance of Eggs as a Food

In presenting the study the homemaker was told: "We are trying to learn about foods used by families, what they like, and reasons for their likes. The information will help food producers and processors improve their products for all of us." Eggs were not mentioned in the first few pages of the schedule.

One of the questions asked in this part of the schedule was: "What foods should your family have every day?" If the interviewee did not mention eggs the interviewer was instructed to ask the next question: "What other protein foods should your family have each day?"

Sixty-two percent of the homemakers named eggs as a food the family should have every day. The place given eggs in this listing was:

Eggs	Percent
Named	62
First	9
Second	13
Third	14
Fourth or later	26
Not named	38

One half of those not naming eggs as a food the family should have each day (19 percent) named them as a protein food the family should have each day. Sixteen percent named them first, 2 percent second, and 1 percent third, fourth, or fifth. This means that about four out of every five homemakers consider that eggs are a food or a protein food the family should have each day.

Factors related to naming eggs as a food or protein food the family should have each day were place of residence (town, village), race, education of homemaker, and income of family the past

Table 7. Type of producers from whom merchants buy eggs, by season.

Type of producer	In winter	In Spring
	Percent	Percent
Mississippi commercial	78	41
Mississippi commercial & hatchery	1	2
Mississippi Commercial, hatchery & local farm	1	0
Mississippi commercial & local farm	8	26
Hatchery only	0	2
Shipped commercial only	1	7
Shipped commercial & Mississippi commercial	4	3
Local farm only	7	18
Hatchery & local farm	0	1
Total No.	75	96

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[5] By location is meant towns and villages in which study was made.

year.[6] More town than village homemakers, and more white than Negro women said "eggs." Homemakers with more than eighth grade schooling named eggs more than did those with less schooling. There was, however, no difference between replies of high school graduates and those with college training.

Homemakers from families with higher income more often named eggs as a food or protein food their family should have each day, as is shown in Table 8.

Serving Eggs

Special Dishes. Every homemaker was asked: "Are there any members of the family such as elderly people or persons on special diets who receive eggs or egg dishes prepared especially for them and not served to the other members of the family? If yes, tell what dishes are served to them. If yes, tell why."

One hundred and twenty-seven of the 1756 homemakers stated there were people in the family who had egg dishes especially prepared for them. About two-thirds (64 percent) mentioned soft cooked or soft boiled eggs. Other ways of preparation mentioned were poached, milk shake, egg nog, egg yolk, raw eggs, whites only, baked or boiled custard.

Only one of the factors examined — age of homemaker — was related to preparation of these special dishes. Homemakers under 30 years of age and 60 years and over more often reported persons receiving eggs or egg dishes especially prepared for them and not served to other members of the family.

Some of the reasons given for serving egg dishes to individuals in the family and not served to other members were: bad stomach; diabetic, can't be cooked in grease; doctor's orders; children shouldn't eat fried eggs; boiled eggs good for small children; small son needs to eat soft boiled eggs; have ulcers; reducing; heart trouble.

All reasons given except two involved health. These two reasons involved personal likes or dislikes of the individual.

Eggs For Breakfast. Homemakers were asked about main dish served their family at breakfast each day during the past week. When eggs were mentioned they were asked how these were prepared. Main dishes served for breakfast by the 1756 families during the past week were as follows:

Main dishes	Percent*
Meat (all kinds) and eggs	40
Eggs only	28
Bread, grits, rice, pancakes	11
Cereal (with milk)	9
Meat only (all kinds)	5
Other protein combinations (with or without eggs)	3
Drink only** or nothing	3

*Less than 1% served as main dish: dried eggs, cheese or cheese toast, or fruit or fruit juice only. These three equalled about 1%.
**Coffee, tea.

Eggs might be classified as the main breakfast food of the families surveyed. There was no day of the week on which eggs were served more than on any other. They had been served by about 1200 of the 1756 families each morning during the past week.

There was a highly significant relationship between serving eggs for breakfast and race, season, education and age

Table 8. Homemakers from families with less than $2,000 income and with $6,000 and over income, classified by whether named eggs as a food or a protein food their family should have each day.

Place given eggs	Income of Less than $2,000	Income of $6,000 and over
	Percent	Percent
Named eggs as a food needed every day	60	63
Named eggs as a protein food needed every day	14	19
Did not name eggs	26	18
No. families	480	339

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[6] Relationship of all these factors and naming eggs was highly significant according to chi-square tests.

of homemaker, and family income.[7] The relationship between whether eggs were served at breakfast and whether homemakers had work away from home was significant at the 5 percent level, with employed homemakers serving more.

White families, families interviewed in the spring, families in which the homemaker was middle-aged (40 — 59 years) and had a high school education or more, and high income families more often reported use of eggs at breakfast than did other families.

At the 8575 breakfast meals in which eggs were served, the eggs were cooked as follows:

Method of cooking	Percent
Scrambled	44
Fried	40
Poached	4
Soft boiled or soft cooked	3
All other	9

There was a highly significant relationship between method of cooking eggs and education of homemaker, place of residence, race, and size of family. Village families, Negro families, families of 6 or more members and families with homemakers having 8th grade or less schooling more often reported having scrambled rather than fried eggs. This may be related to the fact that one can make scrambled eggs go further than fried eggs. In other words, one would fry 4 eggs, one for each family member, but might scramble 3 eggs.

Eggs At Noon Meal. Most of the families in this study had their main meal at noon; that is, they followed the traditional Southern small town or village pattern. However, there were a few who ate lunch at noon. Only 241 of the 1756 families served eggs at the noon meal during the week preceding the interview. The methods of preparing these eggs were as follows:

Method of Preparation	Percent
Deviled, hard cooked, stuffed	60
Scrambled	20
Poached	3
Sandwiches	4
Eggs and meat	2
Fried	1
All other, including those naming more than one	10

Only three of the 241 named two egg dishes prepared for the noon meal during the past week. None named more than two. This means that egg dishes are not too popular as noon-meal dishes among the group surveyed.

Eggs At Evening Meal. Egg dishes were much more popular at the evening than at the noon meal. Seven hundred and thirty (about four-tenths) had served eggs once or twice at the evening meal during the report week. Fifty-three of the homemakers named two egg dishes served during this period. The methods of preparing these eggs were:

Method of Preparation	Percent
Deviled, hard cooked, stuffed	44
Scrambled	39
Fried	4
Poached	2
Eggs and meat	2
Sandwich	1
All other, including those naming more than one	8

The method of preparation of eggs at the evening meal followed the pattern of the noon meal, except that deviled, hard cooked, stuffed eggs were less important and scrambled eggs more important at the evening meal. Deviled, hard cooked, stuffed eggs were often used with lettuce as a salad.

Members of Family Not Eating Eggs

Every interviewee was asked: "Is there any member of the household who does not eat eggs: If yes, why?" One hundred and sixty-seven of the 1756 families (less than 10 percent) reported a member or members of the household who did not eat eggs. Reasons given for not eating were as follows:

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[7] Significant at the 1% level.

Reasons*	Percent
Dont like	63
Health	30
Gave no reason	7

*none gave both "don't like" and "health" reasons.

Some typical replies were: can't eat, makes sick; don't like; don't care for them; doesn't like taste; can't digest; because of health; doctor's instructions; children don't like them, just doesn't like them; allergy; cholesterol.

Thoughts Connected With Eggs

It was considered desirable to determine the attitude of the homemakers towards eggs. The following question was designed for this purpose: "When someone says 'eggs' what is the first thing that pops into your mind?" Only two percent expressed actual distaste or dislike of eggs. There is, in other words, no deep-seated prejudice about eggs on the part of these village and town homemakers.

Most women associated eggs with chickens. This fact is no doubt related to the sample of families being drawn from villages and towns where some families raised a few chickens on their own, and other families had neighbors and friends who raised chickens. Furthermore, chickens had been kept at parental home sites of most of the interviewees.

How Often and Where Buy Eggs

Most families purchased eggs weekly as noted from the foregoing tabulation:

Frequency of buying	Percent
Weekly	59
No set time	18
2 or 3 times a week	10
Less than once a week	5
Don't buy	8

Included in the "don't buy" group were all or most of the 107 families who had their own flocks; 36 families with relatives such as mother or brother giving them eggs regularly; 3 families who had both home-produced and gift eggs; 2 families getting dried eggs as part of the government welfare program; and one family who used no eggs.

A highly significant relationship was found between frequency of buying eggs and place of residence, size of household, composition of family, family income, and amount spent for food per person per meal. Village families, larger families, families with children, families with higher income ($6,000 and over), and families who had spent 50c or more per person per meal during the past year purchased eggs more frequently than other families.

Every homemaker was asked: "From whom do you buy most of your eggs?" About two-thirds mentioned a grocery store or other retail outlet, as is shown:

Place of Purchase*	Percent
Grocery or other retail outlet	65
Commercial producer, grading plant	10
Other (farmer, peddler)	16
More than one source	1
Don't buy	8

*Four families had eggs delivered by dairy, and two families gave no information.

Place where eggs were bought differed significantly between season, race, place of residence, and family income.[8] More reported grocery store and other retail outlets in winter than in spring. More Negro than white families and more low income than higher income families reported buying eggs from grocery or other retail outlet. More town than village families reported they bought from commercial producers and grading plants. This is no doubt related to the fact that there were more commercial producers in and around the towns surveyed.

The relationship between place where purchased most eggs and cost of food per person per meal was significant at the 5 percent level. In other words, more of the low per capita spenders purchased eggs at grocery stores or other retail outlets.

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[8] Significant at the 1% level, according to chi-square tests.

Homemakers were asked why they bought eggs from this source. Reasons given were:

Reasons	Percent
Convenience (where I trade, close to house, delivered, they charge)	55
Quality and/or size (fresh, infertile, graded)	22
Cheaper (same price year round)	8
Relative, friend, employer, business or political reasons, including own store	3
Other	1
No reason, don't know	3
Don't buy eggs	8

Convenience was the main reason given for buying eggs where they did. Only about one in five mentioned quality and/or size of eggs.

Amount of Eggs Bought

Usually At One Time. Families most often purchased about two dozen eggs at a time, but about three dozen and one dozen were also popular purchases. The number of eggs usually bought at one time was as follows:

Eggs bought at one Time	Percent
Don't buy	8
6 or less	1
7 - 17	23
18 - 23	4
24 - 35	37
36 and over	26
No reply	1

The relationships between amount of eggs purchasd at one time and race, size of household, and income were significant at the 1 percent level. In other words, white families, larger families, and families with more income usually purchased more eggs at one time.

Last 7 Days. Homemakers reported that during the last 7 days they had bought the following amounts of eggs:

Eggs Bought Past 7 Days	Percent
Didn't buy any	15
6 or less	1
7 - 17	14
18 - 23	2
24 - 35	33
36 - 47	19
48 - 59	**10**
60 or more	6

There was also a highly significant relationship between number of eggs bought last 7 days and race, size of household, and income. White families, larger families, and families with higher income had bought more eggs in the last 7 days.

The 264 families who had stated that they did not buy eggs during the last 7 days were asked why not? The following reasons were given:

Reasons didn't buy	Percent
Home flock is laying	43
Had enough on hand	30
Received as gift	16
Can't afford, too high	7
Didn't want them	3
Other	1

Use of Eggs

When asked, "How many eggs did you use the past week?", homemakers replied as follows:

Eggs used past week*	Percent
None	2
6 or less	4
7 - 12	18
13 - 24	37
25 - 36	24
37 - 60	13
Over 60	2

*Two families used dried eggs from welfare.

Those families who did not use eggs gave as their reasons: too expensive; couldn't afford; didn't want; hens aren't laying.

Eighty-eight percent of the families using eggs purchased all eggs. Seven percent of the families obtained eggs from home flocks, and 3 percent received their eggs as gifts. The remaining received eggs from more than one source, i.e. purchased and home-produced, purchased, and gifts. There was a highly significant relationship between amounts of eggs used the past week and race, size of household and family income. White families, larger families, and families with higher income had used more eggs the past week.

As will be noted from Table 9, there was a wide variation in smallest and largest number of eggs used per family during a week. Only 4 percent of the families named 4 dozen or more as the smallest amount and 30 percent named it as the largest amount.

Table 9. Smallest and largest number of eggs used during a week.

Amount of eggs	Smallest number	Largest number
	Percent	Percent
None	3	0
Less than 12	13	2
12 - 23	37	13
24 - 35	30	22
36 - 47	11	27
48 and over	4	30
No answer	2	2

Reasons given for variation in amounts of eggs used from week to week were:

Reasons for variation in egg use	Percent
Company or extra cooking	50
Changes in appetites and tastes	14
Holiday cooking	6
Depends on price	5
Doesn't differ	15
All other	10

Every homemaker was asked the number of eggs used the past week in main egg dishes and the number used in cooking as in breads, desserts, salads, casseroles, etc. They reported as follows:

Use of eggs in main dishes and other ways*	Percent
No eggs in main dishes	3
Less than ½ in main dishes	8
½ - ¾ in main dishes	57
Over ¾ in main dishes	22
All in main dishes	8
Not used	2

*Two families used dried eggs from welfare.

There was a highly significant relationship between the use of all eggs in main dishes and race, place of residence, income of family, and schooling of homemaker. Negro families, town families, families with lower income, and families with homemaker having less than 8th grade schooling had more often used all their eggs in main egg dishes than had white, village, higher income families, and families with homemaker having 12th grade education or more.

Home-Produced Eggs Used

About 8 percent of the families included in this study had used some home-produced eggs during the week preceding the interview. However, 13 percent of the families had kept some laying hens during the past year. Six percent had kept 10 or less hens, 5 percent from 11 — 20 hens, and 2 percent more than 20 hens. When asked about how many months hens lay, homemakers replied as follows:

Months	Percent
Less than 4	2
4 - 5	1
6 - 9	5
Over 9	4
Don't know	1

Ten percent of the women reported that while hens were not laying they bought eggs for home use. The other three percent did not buy.

One to three dozen per week was the most frequent amount of eggs families got when hens were laying. Five percent of the 13 percent with laying hens got this amount. Two percent reported getting less than a dozen; 2 percent from 5 to 7 dozen; 2 percent over 7 dozen; and 2 percent said, "Don't know" or "Couldn't find."

Percent of Recommended Amount Used and Opinion of Homemaker as to Adequacy

In a low-cost food plan developed by the Consumer and Food Economics Research Division of the Agricultural Research Service of the U.S.D.A., the following weekly quantities of eggs are suggested: (a) for children under 7 years and for women, 5 eggs per week; (b) for children 7 — 19 years and for men, 6 eggs per week.[9] The recommended amount of eggs was calculated for each family. These figures were compared with amounts used. The percentages of recommended amounts used by the 1756 families were as follows:

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[9] Family Food Plans and Food Costs, Home Economics Research Report No. 20, Agricultural Research Service, USDA, 1962, p.9. "Another Food Plan at Low Cost. Especially suitable for food habits of families in the Southeastern States."

Percentage of Recommended Amounts Used	Percentage Using*
Did not use eggs	2
1 - 50	6
51 - 75	10
76 - 99	11
100 - 150	28
151 - 200	18
Over 200	25

*Two families used dried eggs from welfare.

Twenty-nine percent of the families (about one third) used eggs in smaller amounts than recommended. On the other hand, one fourth used over 200 percent of the recommended amounts. There was a highly significant relationship between percentage of recommended amount of eggs used and residence, race, size of household, and amount spent for food per person per meal. More town families, Negro families, larger families, and families with low expense per person per meal used eggs in smaller amounts than recommended.

Homemakers were asked if they thought the amount of eggs their families used was about right, more than needed, or less than needed. (Table 10 classifies their replies by the percentage of recommended amount of eggs the family used).

There was a highly significant relationship between homemaker's answer to the above question and the percent of the recommended amount of eggs used. In other words, homemakers know more than they actually put into practice about the egg supply for their families.

Knowledge of Homemaker About Nutritive Value of Eggs

Each homemaker was asked the following question: "Mrs. Smith had planned to serve scrambled eggs for the family's evening meal but found she was out of eggs. She had materials on hand to fix (1) macaroni and tomatoes, (2) hamburger, (3) pork and beans, (4) cooked cabbage flavored with pork fat or oleo. Which should she serve to take the place of eggs?"

The 1756 women replied as follows:

Dishes to replace eggs	Percent
Hamburgers	55
Macaroni and tomato	27
Pork and beans	10
Cooked cabbage	7
No report	1

This means that the majority of women had some knowledge concerning the nutritive value of eggs. The majority classified eggs in the animal protein group; that is, with hamburger. White women, women with more schooling, and women from families with higher income more often named hamburger than did Negro women, women with less schooling, and women from families with lower income.

Interviewees were asked why they said they would substitute the specified food. In Table 11 reasons given are briefly summarized. As will be noted, nutrition statements regarding hamburgers and pork and beans were more often right than wrong. However, those regarding macaroni and tomato and cabbage were more often wrong than right. A number

Table 10. Opinion of homemaker as to amount of eggs used by her family by percentage of recommended amounts used.

	Percentage of Reccommended Amount						
Opinion	1-50%	51-75%	76-99%	100-150%	151-200%	Over 200%	Total
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
About right	33	64	70	84	89	91	80
More than needed	6	2	3	4	4	7	4
Less than needed	57	25	21	10	5	1	13
Don't know or no reply	4	9	6	2	2	1	3
No. families	102	182	189	493	321	438	1725*

*Thirty-one didn't use eggs or had dried eggs from welfare.

Table 11. Reasons given for substitution of specified foods for scrambled eggs.

Food	Nutrition Reason Was Correct*	Nutrition Reason Was Incorrect*	Likes Taste	Health Reason	Ease of Preparation	No Reason or Other	Total
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Hamburgers	28.9	.4	9.6	1.0	2.2	12.9	55
Macaroni & Tomato	.1	7.8	5.9	.7	.4	12.1	27
Pork & Beans	2.1	1.5	1.5	.2	.7	4.0	10
Cooked Cabbage	.1	1.8	2.7	.6	.2	1.6	7

*These gave a nutrition reason why they would substitute the specific food. Nutrition reasons are classified as whether correct or incorrect.

of women incorrectly stated that macaroni contains eggs. Liking the dish was an important reason for substitution of all four foods.

Sources That Influence Buying Extra Eggs

Homemakers were asked: "During the past 3 months, have you at any time bought extra eggs for the family because of an advertisement you saw in the newspaper or on TV, or heard on the radio; a demonstration using an egg dish, etc.?"

Purchase of extra eggs during the past three months because of various sources of information was not frequent, as is shown:

Source of influence	Percent
An ad in newspaper, TV, radio	5
Information or request from husband and children	3
Information from friends or relatives	2
Food articles in magazines, papers, or recipe books	2
A demonstration	1
Advice of doctor or nurse	1
More than one source	1

Mass media and personal influence were equally important in getting family to purchase extra eggs; about 7 percent of the women mentioned each of these.

Eggs on Hand at Time of Interview

The interviewer was asked to check each homemaker's refrigerator for the number and kind of eggs on hand. The following amounts were reported:

Number on hand	Percent
None	9
6 or less	29
7 - 12	25
13 - 24	24
25 - 36	8
37 - 48	2
More than 48	2
No reply, or dried eggs only	1

The amount of eggs on hand at the time of the interview was related to residence, race, size of family, and family income. Town families, Negro families, larger families, and families with lower income had fewer eggs on hand.[10]

Sixty-two percent of the 90 percent of families with eggs on hand had purchased all eggs in a carton; 27 percent had purchased no eggs in a carton; and one percent, part in carton, part not in carton.

Homemakers were asked about storing eggs. Fifty-six percent of the homemakers reported storing in carton. Thirty-one percent reported keeping in some other kind of container and three percent used both ways. Main reasons given by the women for storing in cartons were convenience, protection, keep better, prevents absorption of odors, and have no other place to keep.

The main reasons for keeping in another container were: refrigerator has an egg rack or container, refrigerator tray more convenient; refrigerator absorbs odor of a carton. White families, smaller families, and higher income families more often stored carton eggs in another container than Negro families, larger families, and lower income families.

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[10] Relationship was significant at the 1% level, by chi-square tests.

When asked how much they paid per dozen for eggs on hand, 17 percent reported no eggs, or no purchased eggs on hand. Two percent reported 25c a dozen or less; 13 percent, 26c—39c; 44 percent, 40c—54c; 21 percent, 55c—64c; 1 percent, 65c or more; 1 percent named two prices; and 1 percent said they didn't know. When asked if price is lower or higher than usual and the reason, 56 percent of the 1756 families replied the price was as usual, that they paid about the same price the year around. Only 4 percent mentioned buying on sale and 3 percent buying lower grade or small eggs or cracked eggs. Only 15 percent mentioned the season of the year—spring, more plentiful supply and cheaper; winter, short supply and more expensive. In other words, to many homemakers there did not seem to be much variation in price.

Grade of eggs on hand at time of interview were reported as follows:

Grade	Percent
No eggs on hand, no reply or dried eggs	10
Grade A	50
Grade B	1
Not graded	32
Part graded, part not graded	1
Homemaker in error as to grade	6

Fifty-eight percent of the families reported they obtained their eggs from the grocery or other retail outlet; 8 percent purchased from a commercial producer or grading plant; 14 percent from neighbors, farmers, peddlers, or hatchery; and 1 percent from more than one source. Other eggs on hand were home-produced or gifts. Eight out of nine families with eggs on hand had had them on hand 7 days or less.

Size of eggs reported on hand was as follows: large, 40 percent; medium, 27 percent; small, 1 percent; mixed, 19 percent; more than one size, 2 percent. One percent of the homemakers was in error as to size, and ten percent had no eggs on hand.

Change in Quantity and Quality of Eggs Used in Last Year or So

When homemakers were asked whether in the last year or so the number of eggs used by their family had changed, 75 percent answered, "No change"; 15 percent said, "Use more"; 9 percent, "Use less"; and 1 percent said, "Don't know."

There was a highly significant relationship between change in eggs used and size of household. Small families more often than large families had made no change in the last year or so in the number of eggs used. Reasons for change in the use of eggs was most often related to family composition, new members of the household, children growing, and eating out. Some mentioned "get better eggs" as a reason for using more.

Each homemaker was also asked, "In the last year or so have you noticed any change in the quality of eggs that you buy?" Eighty-five percent said, "No change", 11 percent, "Better eggs"; 2 percent, "Worse eggs"; and 2 percent "Never buy". It would thus seem that homemakers are more aware of change in quantity than quality used.

Knowledge Homemaker Has of Egg Quality

Grade. Homemakers were asked what grade they associated with high quality. Eighty-one percent named grade A or AA: 18 percent didn't know or named other qualities, and 1 percent gave no reply.

Knowledge of homemaker about grade of eggs was related to type of market from which she purchased these eggs as well as personal factors such as schooling and age. There was a highly significant relationship between knowledge of homemaker and trading in an outlet where all eggs were refrigerated, and in an outlet where total egg sales were high.

Homemakers who purchased eggs directly from commercial producers or grading plants more often associated higher quality eggs with grade A or AA than those who purchased from groceries or other retail outlet or from farmers and peddlers.

Homemakers who had lived in the village or town fewer years more often answered grade A and AA as the grade they associated with higher quality. Women who had lived in village or town fewer years, it should be pointed out, were younger women. Younger women, women with more schooling, and women in families with higher incomes more often associated higher quality eggs with grade A or AA. The relationship between all these factors and the knowledge of homemakers about egg grades was highly significant.

Characteristics of high quality eggs. Homemakers were asked two questions to determine characteristics they associated with high quality eggs. These were: "(1) If you wanted to buy high quality eggs and you could get any of the following, which would you choose — (a) eggs from a neighbor's or farmer's flock, (b) farm eggs from the grocery store, or (c) grade A eggs from the grocery store. (2) Top quality eggs must have which of the following characteristics — (a) white shells, (b) large size, (c) a yolk that stands up, (d) light yellow yolks, (e) some other quality, or (f) don't know."

To the first question 54 percent of the women answered grade A eggs from the grocery store; 42 percent, eggs from a farmer or neighbor; 3 percent, farm eggs from grocery. One percent said they did not know. The main reason given for buying grade A eggs from the grocery store was quality (been inspected, fresher, clean, graded, infertile, kept at proper temperature, feel safer). The main reason given for buying from a farmer or neighbor also related to quality of eggs with statements such as: fresh, good flavor or color in brown eggs, richer, best.

Homemakers in Negro families, in low income families, and in families with older homemakers more often said "eggs from neighbor or farmer" than did homemakers in white families, families of higher income and families with younger homemakers. A highly significant relationship was found between association of grade A with quality and stating that they would buy grade A eggs from a grocery.

Characteristics which top quality eggs should have were reported as follows by the 1756 women: yolk that stands up, 85 percent; large size, 23 percent; white shells, 17 percent; light yellow yolk, 10 percent. Other characteristics most often mentioned were dark yolk and brown shell. It is interesting to note that the only correct characteristic of top quality eggs (a yolk that stands up) was voted as a characteristic by 85 percent of the women, and that other characteristics were relatively unimportant.

More white than Negro women replied "yolk that stands up". Older homemakers, homemakers with more schooling and from higher income families more often selected as a characteristic of top quality eggs "a yolk that stands up".

Preference for shell color, yolk color, and size of eggs. None of these 3 items is included in the specifications for quality eggs, yet many homemakers consider them important items. Twenty-one percent of the women interviewed had no preference as to shell color of eggs; 43 percent preferred white shell eggs and 36 percent brown shell eggs. There was a highly significant relationship between preference of shell color and race, age of interviewee, and amount spent per meal per person for food. Low spenders for food, older women, and Negro women more often preferred brown shell eggs. Higher spenders for food per person per meal, white families, and families in which the homemakers were younger, more often preferred white shell eggs. Shell color is not indicative of flavor or nutritive value of eggs.

Principal reasons given for preferring white shell eggs were: (1) exterior appearance (looks cleaner; like color; looks fresher) (2) yolks milder, not so rich; makes food taste better; (3) just prefer; (4) whites beat better; higher grade. Reasons given for preferring brown shell eggs were: (1) yolks richer, tastier, darker, more flavor; makes food taste better; (2) looks better, dirt doesn't show so much; (3) firmer yolks; (4) just prefer.

Only 14 percent of the homemakers had no preference for yolk color. Sixteen percent preferred light yolks, 37 percent dark yolks and 33 percent medium yolks.

As in the case of shell color, low spenders for food, older women, and Negro women more often preferred dark than light yolks. Main reasons given for preferring light-colored egg yolks were: (1) looks—looks better, dark looks rotten, don't make food as dark, right color, looks good in food; (2) taste—mild, not as strong, family likes; (3) just prefer, what I like.

Main reasons for preferring dark egg yolks were: (1) looks — looks richer, looks better, makes food pretty or yellow, the right color; (2) richer—flavor or food value, no mention of appearance; (3) taste — flavor, tastes better, light ones don't taste right, tastes richer; (4) food values — dark yolk from fertile egg, and fertile egg more nutritious, has more carotene, has more protein.

Looks, taste, and "just prefer" were the main reasons given for preferring a medium colored yolk. Some of the statements made about looks included: Don't like real dark or real light eggs; right color for cooking; in-between look; natural; prettier. Some of the statements about taste were: has right taste; dark too strong; more palatable; not strong; light tasteless.

When asked about preference for size of eggs, 9 percent of the homemakers stated they had no preference; 60 percent stated that they preferred large eggs; 30 percent preferred medium eggs; and 1 percent stated they preferred small eggs. This means three out of five women preferred large eggs. More white families, families with younger homemakers and homemakers of more schooling, smaller families, and families of higher income preferred medium-sized eggs than did Negro families, families with older homemakers and homemakers of less schooling, larger families, and families of lower income.

The main reasons given for preferring large and medium eggs, however, were about the same. They were: (1) best size for family; (2) price; (3) habit.

Price of Eggs

Two questions were asked the homemaker about the price of eggs: (1) "What characteristics in eggs are worth an extra price to you; and (2) Which eggs would you buy: 1 dozen grade A medium at 40c, or 1 dozen grade A large at 49c?" When asked about the characteristics in eggs worth an extra price, homemakers replied as follows:

Characteristics	Percent
None	7
Size	13
High quality	43
Size and quality	16
Other characteristics, not size or quality, such as yolk or shell color	15
No answer	6

To be noted is the fact that about three-fourths of the homemakers mentioned characteristics that are related to egg price (i.e., quality and/or size). More town than village homemakers, more Negro than white homemakers, more homemakers with little than more schooling, and more homemakers in families of lower than higher income mentioned characteristics other than quality and size.

Also to be noted is the fact that many homemakers seem to be unable to figure actual difference in cost of medium and large eggs. They were told: "A weekend special offers large grade A eggs at 49c a dozen and medium grade A eggs at 40c a dozen. If you were planning to buy eggs which would you buy and why?" Forty-nine percent said grade A medium, and 50 percent grade A large.

One dozen large eggs weighs 24 ounces (one pound, 8 ounces) and one dozen medium eggs weighs 21 ounces (one pound, 5 ounces). This means 1 ounce of medium eggs costs 1.9 cents and 1 ounce of large eggs costs 2.04 cents, or that these medium eggs cost a little less.

Seventy-one percent of those saying they would buy medium eggs said they were cheaper (more for money). Other reasons given were: habit; best size for family; large and medium eggs same size.

Eighteen percent of those saying they would buy large eggs said they were cheaper. Other reasons given were: habit; more food; large eggs means high quality, I want the best.

Two Recommendations of Home Economists Regarding Use and Cooking of Eggs

Home Economists tell homemakers that lower grade eggs are good for dishes in which appearance and delicate flavor are not so important as in baked dishes, custards, sauces, and salad dressings. Top quality eggs (Grades AA and A) are good for all uses, but most appreciated when poached, fried or cooked in shell. Lower grade eggs can usually be purchased at a lower price than the higher quality eggs. A question was therefore included in the schedule to determine whether the homemaker was aware of difference in quality depending on type of dish. This question was: "Do you buy and use less expensive eggs for general cooking and baking than for table use?" Only 7 percent of the women answered in the affirmative.

There may be several reasons for this, but homemakers were not questioned on this point. In the first place, the choice is usually between grade A and ungraded eggs. Few stores carry grade B eggs, and many homemakers hestitate to buy ungraded eggs. Then it may be somewhat more convenient to purchase one type of egg for all purposes.

From the question asked it would seem that most homemakers do not understand that different qualities of eggs might be used for different purposes.

Home Economists recommend soft scrambling of eggs. Homemakers were asked how well done their scrambled eggs were when served — whether (1) soft, (2) medium, or (3) well done, i.e. hard, dry, brown? Of those who gave a reply 54 percent said soft; 22 percent, medium; and 24 percent, well done. Well done eggs were reported more often by low income families, Negro families, and families in which the wife had less schooling.

Confidence of Homemaker in Egg Quality

A question was introduced in the schedule to determine homemaker's confidence in the quality of eggs she purchased. This question was: "If you are planning to scramble 6 eggs tell exactly what you do, from taking eggs from the refrigerator to putting the cooked eggs on a platter or dish." All answers except 36 fell in three categories, as is shown.

What would do	Percent
1. Break eggs directly in skillet (complete confidence)	11
2. Break all eggs in one bowl and transfer to skillet (some confidence)	68
3. Break into small container; inspect; then empty into large container; transfer to skillet (no confidence)	19

As will be noted, about two-thirds of the families had "some confidence" in quality of eggs they had bought. Surprisingly, homemakers with less education, Negro homemakers, and homemakers from low income families most often had complete confidence; i.e., "put eggs directly in skillet." Standards of this group, however, were lower.

Use of Frozen and Dried Eggs

Ninety-five percent (1667) of the homemakers stated they had never used frozen eggs; 5 percent (89) had frozen them. Most had frozen yolks and whites together with or without additives (salt, sugar, flour). Frozen eggs were usually used in general cooking or baking, rarely as a main egg dish.

Fifty-three of the 89 who had frozen eggs said they were as good as the fresh. The remainder gave derogatory or qualified remarks such as: "flavor not good, didn't taste fresh"; "dry"; "hard"; "good only for certain purposes".

Twenty-three percent (403 women) stated that they had used dried eggs.[11] Most of these had used them in general cooking or baking only. But 46 women (2.6 percent) had scrambled dried eggs.

One hundred and seventy-eight women gave very favorable replies about dried eggs such as: good, no difference, fine, excellent, the best. Eighty-five gave qualified replies about dried eggs, such as: accepted, but not as good as fresh; only good for certain purposes. One hundred and thirty-one gave derogatory replies, such as: do not like flavor; odor bad, wouldn't eat. The remainder gave "other" replies or said they didn't know.

Experience with Poor Quality Eggs

Homemakers were asked three questions regarding experience with poor quality eggs. They were: "(1) When was the last time you cracked an egg that had to be thrown out? What was the matter with it? (2) Have you within the last three months found a broken egg among those you purchased. Was the broken egg purchased in a carton? (3) Which of the following have you found wrong with purchased eggs in the last year (check as many as interviewee mentions): dirty shells, lack of freshness, thinness of shells, blood spots, off-flavor, other (explain)."

To the first question regarding the last time she cracked an egg that had to be thrown out, homemakers answered as follows:

Last time	Percent
Have not cracked an egg that had to be thrown out past year; too long to remember; don't know	56
Preceding or current spring or summer	25
Preceding or current fall or winter	15
Other (time not given but less than 12 months)	3
No answer (including "maid does the cooking")	1

At the time when there were most complaints (spring and summer) relatively more of these complaints came from homemakers who purchased eggs from stores with lowest weekly sales, from stores that did not refrigerate eggs, and from stores which handled some eggs from home flocks.

The two reasons given most often for throwing eggs out were: (1) not fresh — addled, rotten, yellow and white mixed, yellow broke, spoiled, watery, smelled bad; and (2) blood spots—bloody. "Other" reasons given were: contained foreign matter (worms,[12] white specks); spots in yolk, dirty; frozen; egg stuck to carton.

When asked if they had found a broken egg among those purchased within the past three months, 20 percent of the interviewees replied "Yes"; 74 percent, "No"; and 6 percent couldn't remember. About two-thirds (68 percent) of those who had found a broken egg had purchased the eggs in a carton.

The third question dealt with what the interviewee had found wrong with purchased eggs in the last year. Qualities checked were as follows:

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[11] These include dried eggs for feeding infants and dried egg whites in angel food cake mixes. No dried eggs were sold in areas studied but were used in school lunch rooms and were given to welfare clients who may have passed some on to relatives and friends.

[12] This is a rare occurrence and generally in poorly cared for farm flocks.

Quality	Percent Checking*
Dirty shells	13
Lack of freshness	17
Thinness of shells	36
Blood spots	43
Off-flavor	9

*Complaining of these qualities did not always mean the egg was thrown out.

"Other" qualities found wrong with purchased eggs were: foreign objects in eggs (worms, white flecks); spots in yolk; cracked eggs; eggs too small.

Young women and those with more schooling more often mentioned blood spots. Also, there were more complaints about blood spots from homemakers trading in stores selling eggs from home flocks than from those selling only commercial eggs.

Blood spots on the yolks are an abnormality usually detected in candling. Eggs with blood spots of one-eighth inch or more in diameter are classified by egg graders are inedible. Eggs with smaller spots are classified as grade C, but this grade is not found in Mississippi egg markets. The objection to blood spots is based on appearance rather than taste or nutritive value.

Those complaining of thinness of shell, unlike those complaining of blood spots, were not centered in any particular group or groups. However, older women complained somewhat more about thinness of shell than did younger women. Some mentioned arthritis in the fingers which made it difficult to pick up thin shelled eggs from the carton without breaking. Relationship between age and this complaint was significant at the 5% level.

Information Wanted on Cartons

Two questions were asked each interviewee concerning characteristics that she wanted in a carton. The first asked which three of the following five factors she thought most important on a carton: (1) grade; (2) date when eggs were graded and packed; (3) total weight of the dozen eggs; (4) statement that eggs are infertile; and (5) brand name. The characteristics selected were as follows:

Characteristics	Percent choosing
Grade	92
Date	91
Weight	27
Infertile	49
Brand	36

Practically all women named grade and date. More village than town women mentioned infertile. White women with more schooling and higher incomes more frequently selected infertility than did town women, Negro women, and women of less schooling and from families of lower income.

Brand name and weight of eggs were characteristics more often selected by town families, by Negro families, and by families of lower income.

The second question related to which of the 5 characteristics in an egg carton interviewee thought most important and second in importance: (1) attractiveness; (2) method of removing eggs from carton easily; (3) openings so you can see eggs you are buying; (4) a cellophane wrapper over the carton; and (5) other. Those noted as of first importance were:

Characteristics	Percent naming
Attractiveness	15
Method of removing eggs easily	37
Opening so you can see eggs you are buying	41
Cellophane wrapper over carton	4
Other	1
Don't know	2

Characteristics listed as of second or next importance resembled those listed as of first importance. Eighteen percent named attractiveness; 27 percent, method of removing eggs easily; 40 percent, openings so you can see eggs you are buying; 8 percent, cellophane wrapper over carton; 2 percent, other; 5 percent, "don't know."

More town and Negro homemakers, more homemakers with less schooling and of lower income selected as of first importance an attractive carton. More white homemakers, women with more schooling, and from higher income families, more often selected method of removing eggs easily.

When asked why they selected method of removing eggs from carton easily, the majority of women mentioned breaking, dropping, or cracking eggs in the process of removing from cartons. Others did not mention breakage but related other difficulties with cartons such as "eggs too large for carton"; "hard to get big eggs from carton"; "dividers too high"; "can't grasp eggs". A number of women spoke of the time it took to remove eggs from cartons.

More Negro interviewees and interviewees of less schooling and low income selected as of first importance "openings to see eggs." But more white interviwees and interviewees of more schooling and higher incomes selected "cellophane wrapper over carton." Reasons for selection of cellophane wrapper over carton included: keep eggs fresh (prevent evaporation); keep out odors (keep out air); protects from breakage; more easily handled.

Other characteristics of an egg carton which homemakers thought important were: more efficient closure (either so carton won't come open so easily, or so that it can be opened easily); stronger cartons; different shape for cartons; clean plastic top; padded bottom.

Summary

It was the purpose of this study (1) to determine: (a) from representative families, basic factors regarding sources, kinds, amounts, and uses of purchased eggs; opinions concerning changes in quantity and quality of eggs purchased; and sources and kinds of information that influence housewives in purchasing eggs; and (b) from merchants in areas where families resided, quantities and kinds of eggs handled; methods of handling eggs; and changes noticed since state egg inspection program began; and (2) to evaluate local marketing programs now in operation.

Data were obtained during the fall and winter of 1961-62 and the spring of 1962 by personal interview with a representative sample of approximately 125 families in each of 10 towns and 4 villages of Mississippi. Schedules were completed for 1756 families.

Data concerning eggs were obtained from 171 grocery stores, from 41 in 4 villages and from 130 in the 10 towns. Ninety-five of the 171 groceries kept all or part of their eggs refrigerated. These eggs were most often kept at 35° — 40°F. Time of last delivery of eggs was "more than 3 days ago" for only 17 percent of the merchants contacted in the spring and 29 percent contacted in the winter. In both seasons of interview about two-thirds of the merchants had 30 dozen eggs or less on hand.

About one half of both village and town merchants stated they had had fewer complaints about eggs they sold in the past 2 years than before inspection service. These made very favorable comments about eggs since the inspection service. Ninety percent of the women interviewed said the eggs in their town or village were satisfactory. Only one in ten gave qualified replies or indicated dissatisfaction.

When asked about the last time she cracked an egg that had to be thrown out, more women who shopped at grocery stores with a small stock of eggs kept on hand, not having a refrigerator for keeping eggs, and buying part or all of their eggs from home flocks, cited examples of eggs thrown away.

When asked which eggs they would choose, (a) eggs from a neighbor's or farmer's flock, (b) farm eggs from a grocery store, or (c) grade A eggs from a grocery store, 54 percent selected grade A eggs from a grocery store; 42 percent, eggs from a neighbor or farmer. More homemakers from lower income families, Negro families, and families with older homemakers mentioned neighbor or farmer.

The majority of homemakers recognized the importance and place of eggs in family diets. More women from low income families, Negro families, and from families in which homemakers had less schooling, did not know the importance of eggs in the diet.

Twenty-nine percent of the families (about one third) used eggs in smaller amounts than recommended in low-cost food plans of the USDA specialists. More town families, Negro families, larger families, and families with low expense for food per person per meal, used eggs in smaller amounts than recommended.

Fifty-seven percent of the homemakers reported that from one-half to three-fourths of all eggs used during the week preceding the interview were used in main dishes. Relatively more eggs are used in general cooking and baking by white families, village families, higher income families, and families in which the homemaker had more schooling.

Eighty-one percent of the homemakers, when asked what grade was associated with high quality, said grade A or AA. When asked about characteristics in eggs worth an extra price, about three-fourths mentioned quality and/or size.

Younger women, women with more schooling and from families with higher income, more often associated quality eggs with grades A or AA.

When asked about preference for size of eggs, 9 percent of the women had no preference; 30 percent said medium eggs; and 60 percent, large eggs. White families, families with younger homemakers, and homemakers of more schooling, smaller families, and families of higher income, more often preferred medium-sized eggs than did Negro families, families with older homemakers, and homemakers of less schooling, larger families, and families of lower income.

Twenty-one percent of the women interviewed had no preference as to shell color of eggs; 43 percent preferred white shell eggs, and 36 percent brown shell. Fourteen percent had no preference for yolk color. Sixteen percent preferred light yolks, 37 percent dark yolks, and 33 percent medium yolks. Low spenders for food, older women, and Negro women more often preferred dark shell and yolks. Characteristics most often mentioned as wrong with eggs were blood spots and thinness of shells.

When asked which one of five characteristics they wanted in an egg carton, more women voted for (1) a method of removing eggs easily and (2) openings so you can see eggs you are buying. These characteristics were mentioned by relatively more homemakers in white and higher income families, and in families in which the wife had more schooling.

The grade and date when eggs were graded and packed was the information wanted on cartons by most women.

Implications

There are a number of implications in this study for other geographical areas, for producers, for educators, and for merchants.

From all indications the egg inspection program has paid off. Most women with such a service say they associate high quality eggs with grade A or AA. Eighty-five percent were able to select the one correct characteristic of top quality eggs from a list. About one-half of the merchants said they had had fewer complaints since inspection service.

It is important to egg producers that most complaints about eggs come from stores handling eggs from home flocks. Producers must have their eggs graded if they are to continue in egg production. The market for eggs is increasing in these small towns and villages as many families have shifted from home production. Only 8 percent of the 1756 families reported they didn't buy eggs.

Families of low income, Negro families, larger families, families with homemakers of limited schooling, families spending lower amounts per person per meal are in special need of help in planning amounts of eggs to use and how to prepare these eggs. Many of these already realize they are using too few eggs. Use of eggs in general cooking needs more emphasis. Also there is need for more attention toward use of eggs at meals other than breakfast. The facts that shell color is due to breed and yolk color mainly to diet of the hens need to be given attention. These are not characteristics used in grading. These characteristics became important when the best eggs were from home flocks and continue to be important to the older citizen and those with a rural background. Also there is need for more emphasis on eggs as a special bargain during seasons of high production. Education regarding relative size of eggs is needed, since the medium size eggs are often the best buy. Emphasis needs to be placed on the fact that size and quality are different factors.

In merchandizing eggs packers need to pay more attention to the cartons used. An effort should be made to develop cartons from which eggs are easily removable. Also, further testing should be done on openings of cartons so the customer can see the eggs she is buying. It would seem that the date on the carton when eggs were graded and packed would please most shoppers.

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Production of Cotton Without Postemergence Cultivation Or Hand Hoeing

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Production of Cotton Without Postemergence Cultivation or Hand Hoeing

VERNON C. HARRIS[1]

The production of certain row crops without cultivation has been tested in many experiments in the past. With the advent of suitable selective herbicides in recent years, the idea was reactivated. In 1950 an experiment was initiated at Mississippi State University to evaluate the efficiency of current preemergence and post emergence herbicides in controlling weeds in cotton without cultivation. Preliminary reports were made in 1951.[2] The experiments were conducted each year through the 1963 season except in 1960. This is the report on the 13 years of experimentation.

The objectives were (1) to control weeds in cotton without postemergence cultivation or hand-hoeing; and (2) to evaluate selected herbicides alone and in combination applied in the field pre- and postemergence to the crop and weeds. Weed control, type of weed, cost of weed control, and cotton yields were emphasized.

Materials and Methods

The experiment was conducted on Houlka clay loam at Mississippi State University, State College.

A herbicidal oil,[3] 4,6-dinitro-o-sec-butylphenol (DNBP), isopropyl N-(3-chlorophenyl) carbamate (CIPC), and 3-(3,4-dichlorophenyl)-1, 1-dimethylurea (diuron) were the initial herbicides evaluated. In 1959 N-(3,4-dichlorophenyl) methylacrylamide (dicryl) was used in combination with diuron and CIPC. In 1961 disodium monomethylarsonate (DMA) was used in combinations with diuron and dicryl. In 1962 and 1963, 2,4-bis (isopropylamino) - 6 - methylmercapto-a-triazine (prometryne) and alkylarylpoly-oxethylene glycols, free fatty acid isopropanol (X-77 surfactant) were employed in the experiment.

Herbicides were used as preemergent, postemergent, or in combination of pre- and post emergent, as shown in Table 1.

Land preparation was virtually the same each year. Cotton stalks were cut in the fall, and the land was disked or flat broken with a mouldboard plow. In the spring a mixed fertilizer (1,000 lb/A) was applied broadcast on the area and disked into the soil. The seed-bed was prepared flat. Before the cotton was planted the seed-bed was disked shallow to give loose soil for covering the cotton seeds. No further cultivation was done during the season.

The cotton seeds were planted 1" deep with a one-row tractor and planting equipment. They were hill-dropped 8 to 10 seeds per hill and spaced 10" apart in the drill. In 1962 and 1963 the hill-drop attachments were removed and replaced with a drill-type attachment. Quantity of cotton seeds per acre was the same. Row spacing varied from 26" to 40". Empire Coker, Delfos 9169, Delta and Pine Land, Fox, Rex, and Stoneville cot-

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[2] Harris, Vernon C. Weed control in cotton without the aid of cultivation. Proc. SWC 4: 85-86. 1951, and Mississippi Farm Resarch Vol. 15, No. 2, 1-3.

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[3] LHO-1—a herbicidal oil with a boiling range of 305-410°F, aromatics 22-24%, maximum aniline point 128°.

The author acknowledges the cooperation of the Lion Oil Company (LHO-1), the Dow Chemical Company (DNBP), the Columbia-Southern Chemical Corporation (CIPC), E. I. duPont de Nemours and Company (diuron), the Niagara Chemical Division (dicryl and DMA), the Geigy Chemical Company (prometryne), and the Colloidal Products Corporation (X-77 surfactant) for supplying the experimental compounds.

Table 1.—Weed control in cotton without postemergence cultivation or hand-hoeing over a 13-year period.

Treatment			Year	Seasonal weed control rating	Cost of herbicide or hand-hoeing per acre ($)	Seed cotton yield (lb/A)	Return ($) per acre	
No.	Pre-emergence	Postemergence					Gross	Less weed control cost
1	DNBP	Herbicidal oil	1950	9	$19.45	3750	$499.50	$480.05
2								
3		Cult. and hoeing		9	21.00	2010	280.70	259.70
1	DNBP	Herbicidal oil	1951	9	23.50	2792	362.40	338.90
2								
3		Cult. and hoeing		9	25.00	3610	468.80	443.80
1	DNBP	Herbicidal oil	1952	9	22.50	2555	280.26	257.76
2	CIPC	Herbicidal oil		9	35.00	2383	261.41	226.41
3		Cult. and hoeing		9	32.10	2020	221.70	189.60
1	DNBP	Herbicidal oil	1953	9	22.50	2842	312.62	290.12
2	CIPC	Herbicidal oil		9	27.20	3038	334.18	306.98
3		Cult. and hoeing		9	26.40	2300	253.20	226.80
1	CIPC	Herbicidal oil	1954	9	22.20	1740	191.40	169.20
2	Diuron	Herbicidal oil		9	20.00	1700	187.00	167.00
3		Cult. and hoeing		9	18.40	1830	201.30	182.90
1	CIPC	Herbicidal oil	1955	9	19.50	3016	331.76	312.26
2	Diuron	Herbicidal oil		9	14.00	2509	275.99	261.99
3		Cult. and hoeing		9	26.60	2500	275.00	248.40
1	Diuron	Herbicidal oil	1956	8	11.00	3555	354.78	343.78
2	CIPC	Herbicidal oil		7	19.50	3084	307.78	288.28
3		Cult. and hoeing		9	17.50	2520	251.50	234.00
1	Diuron	Herbicidal oil	1957	8	11.50	2590	284.90	273.40
2	CIPC	Herbicidal oil		7	27.00	2586	284.46	257.46
3		Cult. and hoeing		9	15.00	1800	198.00	185.00
1	Diuron	None	1958	7	9.50	2410	265.10	255.60
2	CIPC	None		6	25.00	2000	220.00	195.00
3		Cult. and hoeing		9	13.00	1900	209.00	196.00
1	Diuron	Dicryl	1959	9	9.50	2620	340.00	330.50
2	CIPC	Dicryl		8	25.00	2570	332.30	307.30
3		Cult. and hoeing		9	14.50	2070	267.80	253.30
1	Diuron	DMA + Dicryl	1961	8	13.00	2300	253.00	240.00
2								
3		Cult. and hoeing		9	20.50	1220	242.00	229.60
1	Diuron	Diuron + X-77	1962	9-10	16.00	2560	281.60	265.60
2	Prometryne	Prometryne +X-77		8	11.00	2500	275.00	240.00
3		Cult. and hoeing		9	12.40	2200	134.20	113.70
1	Diuron	Diuron + X-77	1963	9	12.00	2992	329.12	317.12
2	Prometryne	Prometryne +X-77		8	14.00	2720	299.20	285.20
3		Cult. and hoeing		9	13.80	2312	254.32	240.52
13-YEAR AVERAGE (1950-63)								
1. No cult.-herbicide weed control			1950-63	8.7	16.29	2748	314.35	298.02
3. Cultivation and hand-hoeing			1950-63	9.0	19.70	2176	250.55	231.02
Difference in 1 and 3				0.3	3.41	572	63.80	67.00

ton varieties were used over the thirteen years.

DNBP was the first potential preemergence herbicide, followed by CIPC, diuron, and prometryne. LHO-1 was the only postemergence herbicide known to be worth testing until 1959. Dicryl showed postemergence herbicidal potential in 1959 and was incorporated in the test. In 1961 DMA was brought in focus as a herbicide by the work of Jack T. Thompson[4] in Georgia. Prometryne and diuron with the addition of a surfactant applied as postemergence herbicides were included in the tests in 1962-1963.

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[4] Thompson, Jack T. Weed control activity of dicryl enhanced in mixture. Proc. SWC 14: 48-49. 1961.

Preemergence herbicides were applied broadcast immediately after planting with a pull-type sprayer equipped with a boom-type applicator. Postemergence treatments were applied with a 3-gallon compressed air sprayer. The postemergence treatments were applied on a broadcast basis. The spray was directed to the cotton plants at a 45° angle. Insecticide applications averaged ten per year.

The size of the plots varied from year to year but they were at least eight or more rows each 150 feet long. The plots were randomized and replicated three or more times.

Weather conditions were mostly favorable each year at the time of planting. Rain occurred between planting and emergence of the cotton 11 of the 13 years. Four years were dry and hot, five were nearly normal, and three had excessive rainfall in the spring and fall.

Weed-control and crop-plant data were taken several times during the season. Weed control ratings were based on values of 0-10, with 0 equalling no weed control and 10 perfect weed control. Data given is the mean average of the replicates of each treatment. Yields of seed cotton per acre were obtained by computing the means from all the replicates.

Results and Discussion

The row spacing of 28" to 30" apart was the most satisfactory. Row spacing was restricted because of type of cotton planter used. In order to vary all the row widths satisfactorily, special equipment would have been required.

Cotton plant populations per acre varied from 66,000 to 100,000 plants according to the row widths planted. Approximately 85,000 cotton plants per acre resulted in best weed control and yields. The 30" row spacing resulted in 85,000 plants per acre. In the years of excessive rainfall during the harvest season, the cotton rotted where 100,000 cotton plants per acre were present.

The cotton plants on non-cultivated plots produced blossoms 4 to 5 days earlier than those on the cultivated plots. In dry years the cotton plants on the non-cultivated plots did not show moisture deficiency as soon as those on the cultivated. The difference was 10 to 12 days. Some of the cotton plants on the non-cultivated and cultivated plots were dug up during one of the dry years; in the non-cultivated plots the roots were 1 to 2 feet deeper in the soil than on the cultivated plots.

The herbicidal treatments in Table 1 project the current promising herbicides in a particular year. No herbicide used caused severe injury to cotton plants Some minor injuries such as the discoloration of the cotyledons and first true leaves resulted from some of the treatments. DMA, diuron, and prometryne caused some yellow discolorations of the cotyledons and primary leaves. These discolorations disappeared in 10 to 14 days and did not become evident again during the season. Dicryl caused stunting of the cotton plants and a light green color of the sprayed leaves.

Weed control by herbicides was very satisfactory and in most years was equal or superior to that in the cultivated and hand-hoed check. In the 13-year averages on weed control shown in Table 1 Treatments 1. (Chemical) and 3 (hand hoed) were rated only 0.30 apart, based on a scale of 0 to 10. Data in Table 1 show that diuron applied as preemergence treatment and diuron plus a surfactant applied as a postemergence treatment were the most satisfactory treatments. The weed-control ratings were made on annual weeds, not on perennials such as nutsedge and Johnsongrass. No herbicide used in the experiments controlled these two weeds. The experiment was conducted at another location on plots infested with **Cyperus rotundus** L. (nutsedge), and the weed completely took over the area in 3 years. Cultivation plus hand-hoeing was not rated 10 in weed-control, because the cotton choppers did not do a perfect job of hoeing.

The average annual cost of weeding the cotton with herbicides was $16.29 per acre and $19.70 for cultivation and hand-hoeing. Thus the use of herbicides resulted in an average per acre saving of $3.41. When the cost of weed-control for each pound of seed cotton produced was calculated the herbicide cost was 6 cents per pound and cultivation plus hand-hoeing was 9 cents per pound. Weed-control with herbicides returned $6.58 more per dollar invested in weed-control than cultivation plus hand-hoeing.

Variations in yields from year to year were mainly due to the season and insect populations. The mean yield of seed cotton produced without cultivation was 2748 pounds per acre and with cultivation plus hand-hoeing was 2176 pounds. The no-cultivation plots yielded 572 pounds more seed cotton than the cultivated and hand-hoed. The analyses of variance in Tables 2 and 3 show the mean yield and mean net returns for 13 years to be highly significant at the 1% level of probability.

Table 2.—Yield of seed cotton produced in pounds per acre without cultivation and with cultivation plus hand-hoeing.

Year	No cultivation (Treatment 1)	Cultivated (Treatment 3)
1950	3750	2010
1951	2792	3610
1952	2555	2020
1953	2842	2300
1954	1740	1830
1955	3016	2500
1956	3555	2520
1957	2590	1800
1958	2410	1900
1959	2620	2070
1961	2300	1220
1962	2560	2200
1963	2992	2312

L.S.D. .05 = 362 .01 = 508

Table 3.—Returns in dollars per acre above weed control cost of cotton produced without cultivation and cotton produced with cultivation plus hand-hoeing.

Year	No cultivation (Treatment 1)	Cultivated (Treatment 3)
1950	480.05	259.70
1951	338.90	443.80
1952	257.76	189.60
1953	290.12	226.80
1954	169.20	182.90
1955	312.26	248.40
1956	343.78	234.00
1957	273.40	185.00
1958	255.60	196.00
1959	330.50	253.30
1961	240.00	229.60
1962	265.60	113.70
1963	317.12	240.52

L.S.D. .05 = 46.9 01 = 65.8

Summary

Annual weeds were satisfactorily controlled in non-cultivated cotton by a broadcast application of a pre-emergence and postemergence herbicide.

The cost of weed control by herbicides without cultivation was $3.41 less per acre than the cost of weed control by cultivation and hand-hoeing. Weed control with herbicides without cultivation returned $6.58 more per dollar invested in weed control than was the case with cultivation plus hand-hoeing.

Cotton weeded with pre- and post-emergence herbicides without cultivation produced 572 pounds per acre more seed cotton than that weeded with cultivation and hand-hoeing. The non-cultivated cotton plants fruited earlier and withstood drought longer than the cultivated cotton plants.

Mean yields and mean net returns per acre for 13 years of weeding with herbicides with no cultivation were significant at the 1% level of probability when compared to the weeding with cultivation and hand-hoeing of cotton.

BULLETIN 686 APRIL 1964

Costs And Returns For A Pecan Enterprise

By A. D. SEALE, JR.

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COST AND RETURNS FOR A PECAN ENTERPRISE

By A. D. SEALE, JR.

In recent years many people have been considering pecans as a source of farm income. But time is required to establish a productive grove and annual expenditures will exceed annual returns in the early years. For this reason the cost associated with the time lags between expenditures and returns must be considered when evaluating the feasibility of investing in a particular enterprise.

For those who have investment capital available, interest on the expenditures, during these time lags, represents returns that could have been received for other uses of their funds such as lending to someone else. For those who have to borrow, interest on the expenditures represents a cost for the use of capital.

Since expenses will exceed revenues for several years, the expenditures must be adjusted upward or compounded by the rate of interest. Likewise, revenues which cannot be realized until several years into the future, must be adjusted downward or discounted by the rate of interest.

Some relevant questions are readily apparent: (1) How many years will be required to recover expenses plus interest and what are the annual returns over expenses to be expected thereafter?, and (2) What level of annual returns over annual expenses from an alternative enterprize would be equivalent to the returns from a pecan enterprise?

The objective of this study was to provide information relating to these questions. Prior to investing in a particular enterprise, one would likely analyze the current situation and evaluate recent trends in the industry.

Appendix B is devoted to a summary of pecan statistics.

Expenditures

The annual expenditures considered in this study do not include a cost of land. However, a considerable portion of the land can be devoted to other crops or pasture and it may be possible to recover land rent from supplementary enterprises. Pasturing young orchards during the first five years after establishment is not recommended. However, about 80 percent of the land can be devoted to row crops during the first two years. After the second year the proportion of land that can be used for row crops declined annually to about 40 percent in year 10. Row crops are not usually grown after year 10 but pasturing is a common practice.

Marketing costs were also excluded because of the general practice of buyers purchasing pecans at the farm. If this practice is not followed in a particular area, an allowance must be made for marketing.

The estimated cost of establishing an

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Table 1. Summary of annual cost per acre for pecans.

Age of trees	Labor	Equipment	Materials			Total
			Fertilizer	Spray	Sacks	
(years)		(dollars)				
Establishment[1]	3.12	2.00				29.72
1	2.46	2.00	1.40			5.86
2	2.46	2.00	2.00			6.46
3	1.86	2.00	2.60			6.46
4	1.26	2.00	3.20			6.46
5	4.71	6.87	3.80	1.42	.08	16.88
6	5.20	6.95	4.40	1.78	.10	18.43
7	5.77	7.02	5.00	2.19	.12	20.10
8	6.49	7.13	5.60	2.73	.15	22.10
9	7.36	7.25	6.20	3.40	.19	24.40
10	8.33	7.41	6.80	4.12	.23	26.89
11	9.50	7.58	7.40	4.97	.28	29.73
12	9.50	9.02	8.00	5.97	.33	32.82
13	10.63	9.42	8.60	7.11	.39	36.15
14	11.98	9.88	9.20	8.39	.47	39.92
15	13.45	10.38	9.80	9.84	.55	44.02
16	15.05	10.94	10.40	11.41	.63	48.43
17	16.81	11.54	11.00	13.13	.73	53.21
18	18.71	12.18	11.60	14.96	.83	58.28
19	20.70	12.86	12.20	16.92	.94	63.62
20	22.45	13.53	12.80	18.93	1.03	68.74
21	24.89	14.30	13.40	20.99	1.16	74.74
22	27.07	15.06	14.00	23.12	1.28	80.53
23	29.17	15.78	14.60	25.18	1.40	86.13
24	31.24	16.47	15.20	27.19	1.51	91.61
25	33.22	17.15	15.80	29.10	1.61	96.88
26	35.02	17.77	16.40	30.87	1.71	101.77
27	36.57	18.31	17.00	32.39	1.80	106.07
28	37.90	18.76	17.60	33.68	1.87	109.81
29	38.94	19.10	18.20	34.69	1.92	112.85
30	39.64	19.35	18.80	35.38	1.96	115.13

Source: Summarized from Appendix A, Tables 3, 4, 5 and 7.

[1] Cost of trees and wrapping paper = $24.60.

acre of pecans was $29.72, Table 1. The annual maintenance cost for the first four years amounted to about $6.00 per acre. The expenditures increased annually after year 4; in year 5, they amounted to nearly $17 per acre and were in excess of $100 after year 25. Annual expenditures were made up of payments for labor, equipment, fertilizer, spray materials and sacks. The cost for items of production, types of equipment and performance rates, cultural practices, labor and power requirements, and annual cost for individual operations are shown in Appendix A, Tables 1-7.

The type of equipment available to the pecan industry permits extensive substitution between labor and equipment; consequently there are wide variations in the payments for each of these factors. Even so, the combined payments for labor and equipment are subject to much less variation. Consequently, the costs reported in this study should be fairly representative.

Yields and Prices

Pecans tend to follow an irregular pattern of production and this precludes the prediction of high and low yields over extended periods of time. Therefore the yields used in this study represent averages over extended periods and include years of both high and low yields. Average yields per tree and production per acre based on good management are shown in Table 2.

Prices are reported for improved varieties, seedlings, and all pecans. This analysis is based on prices for improved varieties. During the 15-year period 1948-1962, the United States annual average price per pound for improved pecans ranged from 15 to 41 cents, Table 3. This wide range in prices is a reflection of the alternating production pattern with high prices being associated with low yields and low prices being associated with high yields. The average price for the 15-year period was 27.6 cents per pound.

Table 2. Estimated yield per tree, production per acre, and percentage yield by ages of trees.

Age of trees	Yield per tree	Production per acre (12 trees)	Yield based on 30 yr. old trees
(years	(lbs.)	(lbs.)	(pct.)
5	3.25	39	3.98
6	4.10	49	4.99
7	5.12	61	6.22
8	6.35	76	7.75
9	7.81	94	9.58
10	9.52	114	11.62
11	11.52	138	14.07
12	13.83	166	16.92
13	16.46	197	20.08
14	19.42	233	23.75
15	22.72	273	27.83
16	26.36	316	32.21
17	30.31	365	37.10
18	34.55	415	42.30
19	39.05	469	47.81
20	43.73	515	53.52
21	48.54	582	59.33
22	53.40	641	65.34
23	58.20	698	71.15
24	62.86	754	76.86
25	67.26	807	82.26
26	71.29	856	87.26
27	74.86	898	91.54
28	77.85	934	95.21
29	80.19	962	98.06
30	81.79	981	100.20

Source: Based on estimates shown in Appendix A, Table 8.

*For orchards between 5 and 30 years of age, yield is approximately equal to (yield in preceding year) $\frac{(132 - \text{year})}{100}$. After 30 years of age slight annual increases in yield can be expected.

Table 3. United States average farm price per pound for pecans 1948-62.

Year	Improved	Seedlings	All Pecans
	(cents per pound)		
1948	15.2	10.0	12.2
1949	21.8	17.0	18.8
1950	31.8	25.7	28.8
1951	21.7	17.2	19.7
1952	25.2	18.8	22.1
1953	17.8	14.7	16.3
1954	32.7	25.2	28.6
1955	40.9	29.6	32.8
1956	19.2	17.4	18.5
1957	31.0	21.6	23.7
1958	29.3	26.3	28.1
1959	34.1	31.0	32.5
1960	34.1	28.7	31.0
1961	19.8	16.9	18.4
1962	39.1	31.0	35.2
Average	27.58	22.07	24.45

Source: Agricultural Statistics, -1962, U.S.D.A

The remaining sections of this report are based on seven selected price levels which are centered around a base price of 27.5 cents. The three prices below the base are 15, 20, and 25 cents and the three prices above the base are 30, 35, and 40 cents.

In 1960 Fowler[1] projected pecan prices to 1975 and concluded that the most probable situation would be a gradual upward trend through 1975. His most probable price range, in terms of 1959 dollars, for the period 1959 to 1975 was from 27.5 to 40 cents per pound. For the year 1975, he considered 35 to 40 cents per pound to be the most probable range. Most illustrations in the remainer of this paper are based on a conservative estimate of 27.5 cents per pound.

Gross Returns and Returns Over Expenditures

The average production per acre that can be expected from orchards of dif-

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[1] Fowler, Mark L., Projections of Production and Price of Pecans In the United States to 1975, Department of Agricultural Economics Oklahoma Agricultural Experiment Station Technical Bulletin T-88, November 1960.

Table 4. Gross returns per acre from pecans for specified prices by age of trees.

Age of trees	Cents per pound for Pecans						
	15.0	20.0	25.0	27.5	30.0	35.0	40.0
(years)			——(dollars per acre)——				
5	5.85	7.80	9.75	10.72	11.70	13.65	15.60
6	7.35	9.80	12.25	13.48	14.70	17.15	19.60
7	9.15	12.20	15.25	16.78	18.30	21.35	24.40
8	11.40	15.20	19.00	20.90	22.80	26.60	30.40
9	14.10	18.80	23.50	25.85	28.20	32.90	37.60
10	17.10	22.80	28.50	31.35	34.20	39.90	45.60
11	20.70	27.60	34.50	37.95	41.40	48.30	55.20
12	24.90	33.20	41.50	45.65	49.80	58.10	66.40
13	29.55	39.40	49.25	54.18	59.10	68.95	78.80
14	34.95	46.60	58.25	64.08	69.90	81.55	93.20
15	40.95	54.60	68.25	75.08	81.90	95.55	109.20
16	47.40	63.20	79.00	86.90	94.80	110.60	126.40
17	54.60	72.80	91.00	100.10	109.20	127.40	145.60
18	62.25	83.00	103.75	114.12	124.50	145.25	166.00
19	70.35	93.80	117.25	128.98	140.70	164.15	187.60
20	77.25	103.00	128.75	141.62	154.50	180.25	206.00
21	87.30	116.40	145.50	160.05	174.60	203.70	232.80
22	96.15	128.20	160.25	176.28	192.30	224.35	256.40
23	104.70	139.60	174.50	191.95	209.40	244.30	279.20
24	113.10	150.80	188.50	207.35	226.20	263.90	301.60
25	121.05	161.40	201.75	221.92	242.10	282.45	322.80
26	128.40	171.20	214.00	235.40	256.80	299.60	322.40
27	134.70	179.60	224.50	246.95	269.40	314.30	359.20
28	140.10	186.80	233.50	256.85	280.20	326.90	373.60
29	144.30	192.40	240.50	264.55	288.60	336.70	384.80
30	147.15	196.20	245.25	269.78	294.30	343.35	392.40

Source: Based on yield data shown in Table 2.

ferent ages (Table 2) was multiplied by each of the seven price levels to obtain a gross return estimate for each year for each price level, (Table 4). Annual returns per acre ranged from $10.72 in year 5 to $269.78 in year 30 at the base price of 27.5 cents per pound. Returns would be expected to increase slightly after year 30.

Table 5 has been constructed from expense and revenue data in Tables 1 and 4 to show, for each price level considered, the amounts by which returns can be expected to exceed expenditures annually for a 30-year period. Since pecan trees do not bear until about the fifth year, no revenue can normally be expected for the first four years. At the base price of 27.5 cents for pecans, revenues will not equal annual expenses until the ninth year, and will not exceed them by as much as $30 per acre until the 15th year. At prices of 25 cents or lower, from 10 to 17 years must elapse before an orchard begins to show a return over expenses, even if interest on annual expenses is not considered. From the data shown in Table 5, one can readily detect the year in which returns exceed expenses, but if one considers interest on the net expenditures during the preceding years the break-even year is not immediately obvious.

Cost-Returns and the Rate of Interest

An allowance must be made for the use of capital regardless of the source. Since the appropriate rate of interest varies among individuals, an analysis was made for eight rates of interest and the seven price levels considered in the preceding section.

The decision to establish or not to establish a pecan enterprise may be based on the number of years required to re-

Table 5. Annual return over annual expense per acre from pecans for specified prices by age of trees.

Age of trees	Cents per pound for pecans						
	15.0	20.0	25.0	27.5	30.0	35.0	40.0
(years)			—— (dollars per acre) ——				
1[1]	—35.58	—35.58	—35.58	—35.58	—35.58	—35.58	—35.58
2	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46
3	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46
4	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46	— 6.46
5	—11.03	— 9.08	— 7.13	— 6.16	— 5.18	— 3.23	— 1.28
6	—11.08	— 8.63	— 6.18	— 4.95	— 3.73	— 1.28	1.17
7	—10.95	— 7.90	— 4.85	— 3.32	— 1.80	1.25	4.30
8	—10.70	— 6.90	— 3.10	— 1.20	.70	4.50	8.30
9	—10.30	— 5.60	— .90	1.45	3.80	8.50	13.20
10	— 9.79	— 4.09	1.61	4.46	7.31	13.01	18.71
11	— 9.03	— 2.13	4.77	8.22	11.67	18.57	25.47
12	— 7.92	.38	8.68	12.83	16.98	25.28	33.58
13	— 6.60	3.25	13.10	18.03	22.95	32.80	42.65
14	— 4.97	6.68	18.33	24.16	29.98	41.63	53.28
15	— 3.07	10.58	24.23	31.06	37.88	51.53	65.18
16	— 1.03	14.77	30.57	38.47	46.37	62.17	77.97
17	1.39	19.59	37.79	46.89	55.99	74.19	92.39
18	3.97	24.72	45.47	55.84	66.22	86.97	107.72
19	6.73	30.18	53.63	65.36	77.08	100.53	123.98
20	8.51	34.26	60.01	72.88	85.76	111.51	137.26
21	12.56	41.66	70.76	85.31	99.86	128.96	158.06
22	15.62	47.67	79.72	95.75	111.77	143.82	175.87
23	18.57	53.47	88.37	105.82	123.27	158.17	193.07
24	21.49	59.19	96.89	115.74	134.59	172.29	209.99
25	24.17	64.52	104.87	125.04	145.22	185.57	225.92
26	26.63	69.43	112.23	133.63	155.03	197.83	240.63
27	28.63	73.53	118.43	140.88	163.33	208.23	253.13
28	30.29	76.99	123.69	147.04	170.39	217.09	263.79
29	31.45	79.55	127.65	151.70	175.75	223.85	271.95
30	32.02	81.07	130.12	154.65	179.17	228.22	277.27

Source: Based on data shown in Tables 1 and 4.

[1] Establishment cost plus cost for the first year.

cover expenses plus interest and on the annual return thereafter. For example, suppose an individual plans to use borrowed funds which can be obtained at six percent and that he is willing to plan on the base price of 27.5 cents per pound. At this interest rate-price combination, the accumulated returns will not exceed the accumulated cost plus interest until year 17, Table 6. After year 17, the annual returns over expenditures are $55.84 for year 18 and continue to increase to $154.65 in year 30, Table 5. Slight increases would be expected thereafter.

If one had alternative enterprises which did not require extended time lags between expenditures and returns, such as cotton, additional information may be required. If an alternative enterprise would produce an annual return over expenditures of $15.00 per acre for 30 years, which would be the logical choice, pecans or the alternative? At an interest rate of six percent and a price of 27.5 cents per pound, the equivalent annual income from pecans for the 30 year period is $23.96, Table 7. Thus the returns from a pecan enterprise for the first 30-year period are equivalent to an annual income of $23.96 from an enterprise such as cotton. The returns for other interest rate-price combinations shown in Table 7 can be used for similar comparison.

Table 6. Years required to recover expenses plus interest from a pecan enterprise for specified rates of interest and prices.

Rate of Interest	Cents per pound for pecans						
	15.0	20.0	25.0	27.5	30.0	35.0	40.0
(percent)			— (years) —				
3	XX	21	17	16	15	13	12
4	XX	22	18	16	15	13	12
5	XX	23	18	17	16	14	12
6	XX	24	19	17	16	14	13
7	XX	26	20	18	17	15	13
8	XX	28	21	19	17	15	13
9	XX	XX	22	19	18	16	14
10	XX	XX	23	20	19	16	14

Source: Computed from data shown in Tables 1 and 4.
XX Over 30 years required to break even.

Table 7. Equivalent annual net incomes[1] from pecans for specified rates of interest and prices. 30 year period.

Rate of Interest	Cents per pound for pecans						
	15.0	20.0	25.0	27.5	30.0	35.0	40.0
			— (dollars per acre) —				
3	— 1.48	13.87	29.23	36.90	44.58	59.93	75.29
4	— 3.01	11.11	25.24	32.30	39.36	53.49	67.61
5	— 4.43	8.53	21.50	27.98	34.46	47.43	60.39
6	— 5.75	6.14	18.02	23.96	29.90	41.78	53.66
7	— 6.96	3.92	14.79	20.23	25.67	36.54	47.41
8	— 8.07	1.87	11.82	16.79	21.76	31.70	41.65
9	— 9.09	— 0.03	9.08	13.63	18.17	27.26	36.35
10	—10.03	— 1.73	6.58	10.74	14.89	23.19	31.50

Source: Computed from data shown in Tables 1 and 4.

[1] Equivalent annual net incomes were computed by compounding expenses and discounting revenues for a 30-year period to adjust the net returns to annual income streams.

Summary and Conclusions

The annual expenditures and returns per acre for pecans were estimated for a 30-year period for seven levels of prices. Because of the time lags between expenditures and returns, allowances were made for an interest charge on the accumulated expenditures.

At an interest rate of six percent and a price for pecans of 27.5 cents per pound, 17 years were required to recover expenses plus interest. The annual return over expenses for year 18 amounted to $55.84 per acre and increased annually to $154.65 for year 30; slight annual increases would be expected thereafter. At this interest rate-price combination, the returns from a pecan enterprise for the first 30 years would be equivalent to some alternative enterprise which returned $23.96 over expenses annually. After 30 years the annual income would be in excess of $155 annually.

Results show that unless an individual's planning period exceeds 16-20 years, establishment of a pecan enterprise would not be profitable. For those who are willing to plan over such extended periods, pecans warrant careful consideration as a source of income.

APPENDIX A

Budget Data for a Pecan Enterprise

Table 1. Prices paid for item of production.

Item	Unit	Price/unit
Prices paid:		$
Pecan trees	each	2.000
Fertilizer (6-8-8)	ton	40.000
Fertilizer application[1]	acre	.800
Wrapping paper	roll	1.500
Malathion	lb.	.450
Cyprex	lb.	2.450
Sacks	each	.200
Labor	hrs.	.600
Pecan harvest (picking up pecans only)	lb.	.025

[1] Pecan trees are normally fertilized in conjunction with some other crop or pasture. A charge of $ .80 per acre for application was charged to the pecan enterprise in lieu of the usual labor and equipment cost for fertilizer application.

Table 2. Power and machinery: Estimated life, price, cost per hour of use and performance rates per acre.

Implement	Size or description	Total estimated life	Repair as a percent of new cost	Purchase price	Cost per hour of use: Depreciation	Cost per hour of use: Repairs	Cost per hour of use: Fuel oil grease	Cost per hour of use: Total	Performance rates per acre once over	Size of work crew
		(hrs.)	(percent)	($)	($)	($)	($)	($)	(hrs..)	(no.)
Tractor	Gas, 2-row	10,500	120	2,600	.25	.30	.50	1.05	. .	--
Moldboard	2-12", bottoms	1,125	35	415	.37	.13	.01	.51	1.50	1
Disc harrow	6'	900	60	275	.31	.18	.01	.50	.60	1
Posthole digger	18"	500	60	293	.59	.35	.01	.95	1.00[1]	1
Fertilizer dist.	10"	500	60	320	.64	.38	.01	1.03	.25	1
Rotary mower		600	35	480	.80	.28	.01	1.09	.50	1
Sprayer	35 gpm	3,000	45	3,000	.99	.45	.05	1.50	.76[2]	2
Shaker	cable	2,500	15	200	.08	.01	.01	.10	5.00[3]	3

[1] Performance rates for setting pecan trees (12 trees per acre)

[2] Performance rates based on 30-year old trees—.30 hrs. per application per acre plus (.002) (gallons per acre)

[3] Performance rates based on 30-year old trees—.3 hrs. per acre plus .004 (yield)

Table 3 Labor and power requirements per acre for establishment of pecan orchards.

Description of operation	Performance period	Type of land					
		Sodded			Cultivated		
		Hours/A	Cost		Hours/A	Cost	
		man	equip.	$/A	man	equip.	$/A
		(hrs.)	(hrs.)	($)	(hrs.)	(hrs.)	($)
Lay off rows	Nov.-Mar.	.2	---	12	.2	---	.12
Break land (rows—40% land)	Nov.-Mar.	.6	.6	1.30	---	---	---
Disk	Nov.-Mar.	1.0	1.0	2.15	-	---	---
Dig holes and set trees	Nov.-Mar.	4.0	1.0	4.40	4.0	1.0	4.40
Wrap trees	Nov.Mar.	1.0	---	.60	1.0	---	.60
Total		6.8	2.6	8.56	5.2	1.0	5.12

Table 4. Materials required to establish one acre of pecans.

Materials	Unit	Cost per unit	Units per acre	Cost per acre
		($)		($)
Trees	each	2.00	12	24.00
Paper	roll	1.50	4/10	.60
Total				24.60

Table 5. Specified material requirements and cost per acre of pecan orchards by ages of trees.

	Materials per acre		Materials cost per acre			
Age of trees	Fertilizer[1]	Spray[2]	Fertilizer[3]	Spray[4]	Sacks[5]	Total specified cost
(years)	(lbs.)	(gals.)	($)	($)		($)
1	30		1.40			1.40
2	60		2.00			2.00
3	90		2.60			2.60
4	120		3.20			3.20
5	150	55	3.80	1.42	.08	5.30
6	180	69	4.40	1.78	.10	6.28
7	210	85	5.00	2.19	.12	7.31
8	240	106	5.60	2.73	.15	8.48
9	270	132	6.20	3.40	.19	9.79
10	300	160	6.80	4.12	.23	11.15
11	330	193	7.40	4.97	.28	12.65
12	360	232	8.00	5.97	.33	14.30
13	390	276	8.60	7.11	.39	16.10
14	420	326	9.20	8.39	.47	18.06
15	450	382	9.80	9.84	.55	20.19
16	480	443	10.40	11.41	.63	22.44
17	510	510	11.00	13.13	.73	24.86
18	540	581	11.60	14.96	.83	27.39
19	570	657	12.20	16.92	.94	30.06
20	700	735	12.80	18.93	1.03	32.76
21	630	815	13.40	20.99	1.16	35.55
22	660	898	14.00	23.12	1.28	38.40
23	690	978	14.60	25.18	1.40	41.18
24	720	1,056	15.20	27.19	1.51	43.90
25	750	1,130	15.80	29.10	1.61	46.51
26	780	1,199	16.40	30.87	1.71	48.98
27	810	1,258	17.00	32.39	1.80	51.19
28	840	1,308	17.60	33.68	1.87	53.15
29	870	1,347	18.20	34.69	1.92	54.81
30	900	1,374	18.80	35.38	1.96	56.14

[1] Based on 2.5 lbs. of 6-8-8 per tree per year of age and 12 trees per acre.

[2] Mixture: ½ lb. cyprex and 3 lbs. malathion per 100 gals. gals. of water. Rates based on recommendation for 30-year old trees; rates for other years are proportional to yield.

[3] Includes application cost of $ .80 per acre plus $40.00 per ton for materials.

[4] Based on materials cost shown in Table 1 or $ .02575/ gallon of mixture.

[5] One sack required per 100 pounds of pecans.

Table 6. Labor and equipment requirements per acre for specified operations, by age of pecan trees.

Age of trees	Hoe	Prune	Disk		Mow		Spray[1]		Shake trees[2]		Pick[3] up pecans
	L	L	L	E	L	E	L	E	L	E	L
(years)					——(hours per acre)——						
1	3.0	-- --	--	--	--	--	-- ----	-- ----	---- ----	-- ----	---- ----
2	2.0	1.0	.6	.6	.5	.5	-- ----	-- ----	---- ----	-- ----	---- ----
3	1.0	1.0	.6	.6	.5	.5	-- ----	-- ----	---- ----	-- ----	---- ----
4	-- --	1.0	.6	.6	.5	.5	-- ----	-- ----	---- ----	-- ----	---- ----
5	-- --	-- --	.6	.6	.5	.5	3.82	1.91	1.30	-- ----	1.63
6	-- --	-- --	.6	.6	.5	.5	3.88	1.94	1.63	-- ----	2.04
7	-- --	-- --	.6	.6	.5	.5	3.94	1.97	2.03	-- ----	2.54
8	-- --	-- --	.6	.6	.5	.5	4.02	2.01	2.53	-- ----	3.17
9	-- --	-- --	.6	.6	.5	.5	4.12	2.06	3.13	-- ----	3.92
10	-- --	-- --	.6	.6	.5	.5	4.24	2.12	3.80	-- ----	4.75
11	-- --	-- --	.6	.6	.5	.5	4.38	2.19	4.60	-- ----	5.75
12	-- --	-- --	.6	.6	.5	.5	4.52	2.26	3.30	1.10	6.92
13	-- --	-- --	.6	.6	.5	.5	4.70	2.35	3.72	1.24	8.21
14	-- --	-- --	.6	.6	.5	.5	4.90	2.45	4.26	1.42	9.71
15	-- --	-- --	.6	.6	.5	.5	5.12	2.56	4.83	1.61	11.38
16	-- --	-- --	.6	.6	.5	.5	5.38	2.69	5.43	1.81	13.17
17	-- --	-- --	.6	.6	.5	.5	5.64	2.82	6.12	2.04	15.17
18	-- --	-- --	.6	.6	.5	.5	5.92	2.96	6.87	2.29	17.29
19	-- --	-- --	.6	.6	.5	.5	6.22	3.11	7.65	2.55	19.54
20	-- --	-- --	.6	.6	.5	.5	6.54	3.27	8.31	2.77	21.46
21	-- --	-- --	.6	.6	.5	.5	6.86	3.43	9.27	3.09	24.25
22	-- --	-- --	.6	.6	.5	.5	7.20	3.60	10.11	3.37	26.71
23	-- --	-- --	.6	.6	.5	.5	7.52	3.76	10.92	3.64	29.08
24	-- --	-- --	.6	.6	.5	.5	7.82	3.91	11.73	3.91	31.42
25	-- --	-- --	.6	.6	.5	.5	8.12	4.06	12.51	4.17	33.63
26	-- --	-- --	.6	.6	.5	.5	8.40	4.20	13.20	4.40	35.67
27	-- --	-- --	.6	.6	.5	.5	8.64	4.32	13.80	4.60	37.42
28	-- --	-- --	.6	.6	.5	.5	8.84	4.42	14.31	4.77	38.92
29	-- --	-- --	.6	.6	.5	.5	8.98	4.49	14.73	4.91	40.08
30	-- --	-- --	.6	.6	.5	.5	9.10	4.55	15.00	5.00	40.88

L, denotes labor hours; E, denotes equipment hours.

[1] Two-man crew — 6 applications per year.

[2] Based on hand labor for ages 5-11 years (labor charge $ .60/hr. and $ .02/lb.), data for ages 12-30 are based on data shown in Table 2.

[3] Based on hand labor $ .60/hr. and piece work of 2.5¢/lb.

Table 7. Costs of labor and equipment for specified operations, by age of pecan trees.

Age of trees	Hoe	Prune	Disk		Mow		Spray		Shake trees		Pick up pecans	Total specified cost
	L	L	L	E	L	E	L	E	L	E	L	
(years)						(dollars per acre)[1]						
1	1.80	----	.36	.93	.30	1.07	----	----	----	----	----	4.46
2	1.20	.60	.36	.93	.30	1.07	----	----	----	----	----	4.46
3	.60	.60	.36	.93	.30	1.07	----	----	----	----	----	3.86
4	----	.60	.36	.93	.30	1.07	----	----	----	----	----	3.26
5	----	----	.36	.93	.30	1.07	2.29	4.87	.78	----	.98	11.58
6	----	----	.36	.93	.30	1.07	2.33	4.95	.98	----	1.23	12.15
7	----	----	.36	.93	.30	1.07	2.36	5.02	1.22	----	1.53	12.79
8	----	----	.36	.93	.30	1.07	2.41	5.13	1.52	----	1.90	13.62
9	----	----	.36	.93	.30	1.07	2.47	5.25	1.88	----	2.35	14.61
10	----	----	.36	.93	.30	1.07	2.54	5.41	2.28	----	2.85	15.74
11	----	----	.36	.93	.30	1.07	2.63	5.58	2.76	----	3.45	17.08
12	----	----	.36	.93	.30	1.07	2.71	5.76	1.98	1.26	4.15	18.52
13	----	----	.36	.93	.30	1.07	2.82	5.99	2.23	1.43	4.92	20.05
14	----	----	.36	.93	.30	1.07	2.94	6.25	2.56	1.63	5.82	21.86
15	----	----	.36	.93	.30	1.07	3.07	6.53	2.90	1.85	6.82	23.83
16	----	----	.36	.93	.30	1.07	3.23	6.86	3.26	2.08	7.90	25.99
17	----	----	.36	.93	.30	1.07	3.38	7.19	3.67	2.35	9.10	28.35
18	----	----	.36	.93	.30	1.07	3.55	7.55	4.12	2.63	10.38	30.89
19	----	----	.36	.93	.30	1.07	3.73	7.93	4.59	2.93	11.72	33.56
20	----	----	.36	.93	.30	1.07	3.92	8.34	4.99	3.19	12.88	35.98
21	----	----	.36	.93	.30	1.07	4.12	8.75	5.56	3.55	14.55	39.19
22	----	----	.36	.93	.30	1.07	4.32	9.18	6.07	3.88	16.02	42.13
23	----	----	.36	.93	.30	1.07	4.51	9.59	6.55	4.19	17.45	44.95
24	----	----	.36	.93	.30	1.07	4.69	9.97	7.04	4.50	18.85	47.71
25	----	----	.36	.93	.30	1.07	4.87	10.35	7.51	4.80	20.18	50.37
26	----	----	.36	.93	.30	1.07	5.04	10.71	7.92	5.06	21.40	52.79
27	----	----	.36	.93	.30	1.07	5.18	11.02	8.28	5.29	22.45	54.88
28	----	----	.36	.93	.30	1.07	5.30	11.27	8.59	5.49	23.35	56.66
29	----	----	.36	.93	.30	1.07	5.39	11.45	8.84	5.65	24.05	58.04
30	----	----	.36	.93	.30	1.07	5.46	11.60	9.00	5.75	24.52	58.99

L, denotes labor hours; E, denotes equipment hours.

[1] Based on performance rates shown in Appendix Table 6, and costs shown in Appendix Tables 1 and 2.

Table 8. Expected pecan yields per tree for specified varieties by age of trees.

Variety	Age of trees			
	10—14	15—19	20—29	30 and more
		(pounds of pecans per tree)		
Stuart	10—15	15—20	25—40	35+
Desirable	15—20	20—40	50—100	75+[1]
Farley	15—20	20—40	50—75[1]	?[2]
Elliot	12—18	18—35	35—70[1]	?[2]
Success	15—20	20—40	50—100	75+
Average of mid-point excluding Stuart	16.9	29.1	69.4	—

Source: Estimates furnished by A. C. Gossard, Horticulturist, Crops Research Division, ARS, U. S. D. A., Meridian, Mississippi.

[1] These are projected figures as lower range only goes into lower part of range.

[2] Records not available for these relatively new varieties.

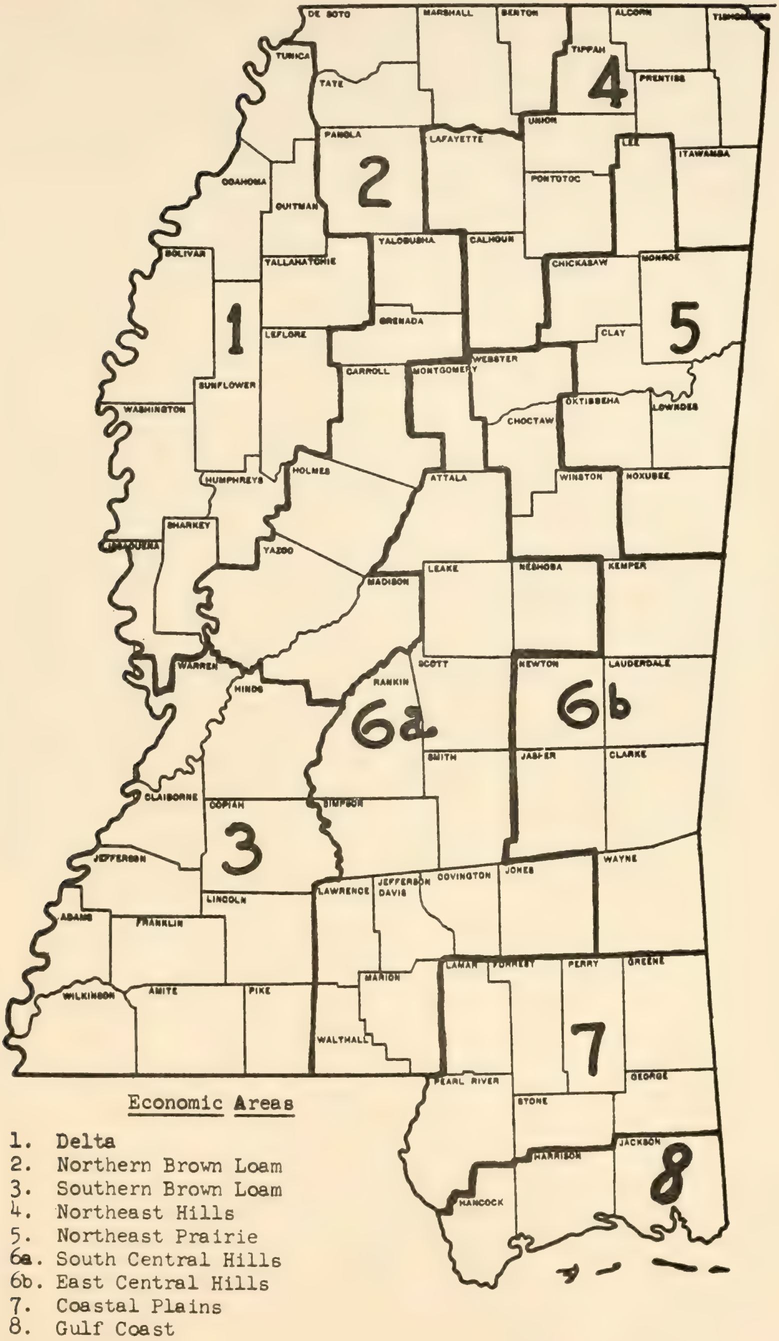
DE SOTO
MARSHALL
BENTON
ALCORN
TISHOMINGO
TUNICA
TIPPAH
4
TATE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
2
COAHOMA
PONTOTOC
QUITMAN
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
BOLIVAR
TALLAHATCHIE
1
GRENADA
5
LEFLORE
CLAY
WEBSTER
CARROLL
MONTGOMERY
SUNFLOWER
WASHINGTON
OKTIBBEHA
LOWNDES
CHOCTAW
HOLMES
HUMPHREYS
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
6a
6b
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
3
JEFFERSON
WAYNE
JONES
COVINGTON
JEFFERSON DAVIS
LAWRENCE
LINCOLN
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
MARION
WILKINSON
AMITE
PIKE
7
WALTHALL
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
8
HANCOCK
Economic Areas
1. Delta
2. Northern Brown Loam
3. Southern Brown Loam
4. Northeast Hills
5. Northeast Prairie
6a. South Central Hills
6b. East Central Hills
7. Coastal Plains
8. Gulf Coast

Figure 1. Economic Areas of Mississippi

APPENDIX B

Summary of Pecan Statistics

Table 1. Recommended pecan varieties by type and variety, Mississippi, 1959.

Type and variety	Trade
Large type	
Stuart	General purpose
Desirable	General purpose
Lewis	General purpose
Small type	
Curtis	Sale to shellers
Elliott	Sale to shellers
Medium type	
Farley	General purpose

Source: Hines, Chesley and Gossard Atherton C., **Pecan Production,** Publication 297 (5M), Mississippi Agricultural Extension Service, State College, Misssissippi, Revised 1959.

Table 2. Number of farms reporting production of pecans and percent change, by type and economic area, Mississippi, 1954 and 1959.

Type and economic area	Crop year 1954[1]	Crop year 1959[1]	Change 1954-1959
	——(farms)——		(percent)
Improved variety			
Delta	685	619	—10
Northern Brown Loam	655	499	—24
Southern Brown Loam	723	689	— 5
Northeast Hills	632	441	—30
Northeast Prairie	475	413	—13
East Central Hills	899	802	—11
South Central Hills	1,153	1,046	— 9
Coastal Plains	1,276	1,171	— 8
Gulf Coast	1,065	796	—25
Total	7,563	6,476	—14
Seedling			
Delta	183	257	+40
Northern Brown Loam	242	201	—17
Southern Brown Loam	446	486	+ 9
Northeast Hills	154	124	—19
Northeast Prairie	136	136	0
East Central Hills	308	337	+ 9
South Central Hills	444	371	—16
Coastal Plains	663	856	+29
Gulf Coast	464	474	+ 2
Total	3,040	3,242	+ 7
Grand Total	10,603	9,718	— 8

Source: United States Census of Agriculture, 1959, Mississippi Counties.

[1] Does not include data for farms with less than 20 trees reporting.

Table 3. Number of pecan trees of all ages with percent change, by type and economic area, Mississippi, 1954 and 1959.

Type and economic area	Crop year 1954	Crop year 1959	Change 1954-1959
	——(farms)——		(percent)
Improved variety			
Delta	40,955	78,992	+92
Northern Brown Loam	12,649	18,098	+43
Southern Brown Loam	36,159	33,174	— 8
Northeast Hills	3,048	2,794	— 8
Northeast Prairie	11,095	8,841	—20
South Central Hills	13,975	22,540	+61
East Central Hills	25,913	13,635	—47
Coastal Plains	91,426	76,056	—17
Gulf Coast	82,304	64,388	—22
Total	317,524	318,117	+ .2
Seedling			
Delta	5,086	12,150	+139
Northern Brown Loam	4,655	4,630	— .5
Southern Brown Loam	22,092	18,391	— 17
Northeast Hills	720	863	+ 20
Northeast Prairie	3,367	2,405	— 29
East Central Hills	5,939	2,932	— 51
South Central Hills	2,729	4,131	+ 51
Coastal Plains	16,496	17,697	+ 7
Gulf Coast	11,625	22,382	+ 93
Total	72,709	85,581	+ 18
Grand Total	390,233	403,698	+ 3.5

Source: United States Census of Agriculture, 1959, Mississippi Counties.

Table 4. Number of pecan trees of bearing age with percent change, by type and economic area, Mississippi, 1954 and 1959.

Type and economic area	Crop year 1954	Crop year 1959	Change 1954-1959
	——(farms)——		(percent)
Improved variety			
Delta	34,854	52,790	+51
Northern Brown Loam	10,503	12,619	+20
Southern Brown Loam	32,759	26,819	—18
Northeast Hills	1,987	1,748	—12
Northeast Prairie	9,287	4,616	—50
East Central Hills	21,442	10,162	—53
South Central Hills	10,461	15,850	+52
Coastal Plains	85,971	70,235	—18
Gulf Coast	73,298	58,628	—20
Total	280,562	253,467	—10
Seedling			
Delta	4,337	7.707	+78
Northern Brown Loam	3,425	3,325	— 3
Southern Brown Loam	17,529	15,265	—13
Northeast Hills	373	299	—20
Northeast Prairie	2,571	1,751	—32
East Central Hills	5,146	2,280	—56
South Central Hills	2,090	2,937	+41
Coastal Plains	14,994	16,172	+ 8
Gulf Coast	9,609	21,321	+22
Total	60,074	71,057	+18
Grand Total	340,636	324,524	— 5

Source: United States Census of Agriculture, 1959, Mississippi Counties.

Table 5. Number of pecan trees not of bearing age with percent change, by type and economic area, Mississippi, 1954 and 1959.

Type and	Crop year		
economic area	1954	1959	Change 1954-1959
	(farms)		(percent)
Improved variety			
Delta	6,101	26,202	+329
Northern Brown Loam	2,146	5,479	+155
Southern Brown Loam	3,400	6,355	+ 87
Northeast Hills	1,061	1,046	— 1
Northeast Prairie	1,808	4,225	+134
East Central Hills	4,471	3,473	— 22
South Central Hills	3,514	6,690	+ 90
Coastal Plains	5,455	5,821	+ 7
Gulf Coast	9,006	5,760	— 34
Total	36,962	65,051	+ 76
Seedling			
Delta	749	4,443	+493
Northern Brown Loam	1,230	1,305	+ 6
Southern Brown Loam	4,563	3,187	— 30
Northeast Hills	347	564	+ 62
Northeast Prairie	796	654	— 18
East Central Hills	793	652	— 18
South Central Hills	639	1,194	+ 87
Coastal Plains	1,502	1,525	+ 2
Gulf Coast	2,016	1,061	— 47
Total	12,635	14,585	+ 15
Grand Total	49,597	79,638	+ 61

Source: United States Census of Agriculture, 1959, Mississippi Counties.

Table 6. Pecan production, average price received by farmers and value, by types, Mississippi, 1944-61.

	Production			Season avg. price per lb.			Value		
Crop year	Improved	Seedlings	All Pecans	Improved	Seedlings	All Pecans	Improved	Seedlings	All Pecans
		(1,000 lbs.)			(cents)			($1,000)	
1944	4,980	4,020	9,000	25.5	16.5	21.9	1,270	548	1,933
1945	3000	4,250	7,250	26.0	19.5	22.2	780	682	1,609
1946	1,920	2,430	4,350	36.5	28.0	31.7	701	680	1,380
1947	1,305	1,595	2,900	32.4	19.0	24.4	418	303	721
1948	4,400	5,100	9,500	16.7	9.4	12.6	735	479	1,214
1949	5,500	4,500	10,000	20.0	15.0	17.6	1,100	675	1,775
1950	1,706	1,994	3,700	32.0	25.0	27.6	546	498	1,044
1951	7,000	6,600	13,600	20.0	15.0	17.4	1,400	990	2,390
1952	2,800	3,200	6,000	24.0	18.5	20.9	672	592	1,264
1953	7,050	10,000	17,050	16.5	14.0	15.0	1,163	1,400	2,563
1954	2,400	2,600	5,000	31.0	23.0	26.6	744	598	1,342
1955	4,500	5,500	10,000	38.0	29.0	32.7	1,710	1,595	3,305
1956	6,100	6,000	12,100	19.0	16.5	17.7	1,159	990	2,149
1957	3,400	4,300	7,700	29.5	21.5	24.7	1,003	924	1,927
1958	7,800	7,200	15,000	25.5	25.5	25.5	1,989	1,836	3,825
1959	2,200	3,200	5,400	36.0	32.0	33.5	792	1,024	1,816
1960	8,500	9,300	17,800	32.5	28.0	30.1	2,762	2,604	5,366
1961	10,500	15,000	25,500	18.5	15.0	16.4	1,942	2,250	4,192

Source: Data for 1944-1948—**Basebook of Mississippi Agriculture,** Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi, 1955. Data for 1949-1961—**Mississippi Agricultural Statistics,** Supplement No. 5, Mississippi Crop and Livestock Reporting Service, Jackson Mississippi, 1963.

Table 7. Pecan production and season average price received by farmers, by states, average 1950-59, annual 1960 and 1961.

Type and state	Production Average 1950-59	 1960	 1961[1]	Price Average 1950-59	 1960	 1961
	——1,000 lbs——			——Cents per lb.——		
Improved varieties						
North Carolina	1,696	2,420	1,300	29.0	34.0	25.0
South Carolina	3,727	3,400	6,800	28.9	32.0	19.5
Georgia	31,760	29,500	55,000	28.4	33.5	19.0
Florida	2,809	900	3,500	27.0	35.0	20.0
Alabama	15,210	13,300	29,000	27.6	34.0	19.5
Mississippi	4,496	8,500	10,000	27.2	32.5	19.0
Arkansas	1,010	2,100	1,000	28.6	33.5	22.0
Louisiana	3,290	4,500	4,000	27.6	33.0	20.5
Oklahoma	1,377	3,000	950	33.6	36.5	28.0
Texas	5,097	4,600	4,500	33.8	35.0	25.0
New Mexico	3,617	8,000	3,700	31.9	38.0	25.0
United States	74,088	80,220	119,750	28.4	34.1	19.8
Wild Seedling						
North Carolina	254	680	200	22.0	25.0	20.0
South Carolina	744	900	1,200	21.8	27.0	15.0
Georgia	6,850	8,200	12,000	22.2	29.0	16.0
Florida	1,970	900	2,000	21.6	27.0	16.0
Alabama	3,170	4,000	6,000	22.2	28.5	15.5
Mississippi	5,059	9,300	10,000	22.0	28.0	16.0
Arkansas	4,200	8,400	3,000	23.6	30.5	18.0
Louisiana	12,950	10,500	31,000	22.7	29.0	16.5
Oklahoma	15,863	38,000	11,050	23.2	29.0	18.0
Texas	27,173	26,400	25,500	23.4	28.0	18.0
United States	78,234	107,280	101,950	22.8	28.7	16.9
Total						
North Carolina	1,950	3,100	1,500	27.9	32.1	24.5
South Carolina	4,471	4,300	8,000	27.5	30.9	18.8
Georgia	38,610	37,700	67,000	27.1	32.5	18.5
Florida	4,779	1,800	5,500	24.8	31.1	18.6
Alabama	18,380	17,300	35,000	26.7	32.7	18.8
Mississippi	9,555	17,800	20,000	24.3	30.1	17.5
Arkansas	5,210	10,500	4,000	24.7	31.1	19.0
Louisiana	16,240	15,000	35,000	23.7	30.2	16.9
Oklahoma	17,240	41,000	12,000	24.0	29.6	18.8
Texas	32,270	31,000	30,000	25.0	29.0	19.0
New Mexico	3,617	8,000	3,700	31.9	38.0	25.0
United States	152,322	187,500	221,700	25.1	31.0	18.4

Source: **Agricultural Statistics — 1962,** U. S. D. A.

[1] Preliminary.

Table 8. Pecan production, season average price per pound received by farmers, and values, United States, 1944-60.

Crop	Improved varieties			Seedling			Total		
year	Production	Price	Farm Value	Production	Price	Farm Value	Production	Price	Farm Value
	(1,000 lbs.)	(Cents)	($1,000)	(1,000 lbs.)	(Cents)	($1,000)	(1,000 lbs.)	(Cents)	($1,000)
1944	61,188	27.7	16,986	80,916	16.9	13,732	142,104	21.5	30,718
1945	59,236	29.2	17,261	79 618	20.0	15,939	138,854	23.8	33,200
1946	33,492	40.2	13,436	42,733	28.8	12,330	76,225	33.7	25,766
1947	45,193	29.4	13,311	74,409	18.3	13,690	119,602	22.3	27,001
1948	77,532	15.2	11,843	98,511	10.0	9,854	176,043	12.2	21.697
1949	50,105	21.8	10,929	75,585	17.0	12.825	125,690	18.8	23,754
1950	62,788	31.8	19,996	61,842	25.7	15,905	124 630	28.8	35,901
1951	88,600	21.7	19,289	68,135	17.2	11,738	156,735	19.7	31.027
1952	79,570	25.2	20,023	71.866	18.8	13,519	151,436	22.1	33,542
1953	106,215	17.8	18,942	107,955	14.7	15,912	214,170	16.3	34,854
1954	43,800	32.7	14,292	50,800	25.2	12,765	94,600	28.6	27,057
1955	42,800	40.9	17,492	104,500	29.6	30,939	147,300	32.8	48,431
1956	106,850	19.2	20,503	67,550	17.4	11,784	174,400	18.5	32,287
1957	34,160	31.0	10,600	107,440	21.6	23,214	141,600	23.7	33,814
1958	105,900	29.3	31,001	67,450	26.3	17,738	173,350	28.1	48,739
1959	70,200	34.1	23,953	74,800	31.0	23,188	145,000	32.5	47,141
1960	80,220	34.1	27,326	107,280	28.7	30,797	187,500	31.0	58,123
1961[1]	119,750	19.8	23,712	101,950	16.9	17,224	221,700	18.4	40,836

Source: **Agricultural Statistics—1962,** U. S. D. A.

[1] Preliminary.

BULLETIN 687 APRIL 1964

Micronutrient Deficiencies of Cantaloupes As Related to the Proximity and Profile Of the Subsoil Level

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Micronutrient Deficiencies of Cantaloupes as Related to the Proximity and Profile of the Subsoil Level.

By S. S. IVANOFF

Deficiency diseases caused by lack of micronutrients are common and worldwide (7). They have been encountered in Mississippi for some time (1, 4, 5, 6). Their symptoms may be very characteristic and striking in some cases, but they also may be inconspicuous and common in character, showing only as stunting or lack of vigor. It may be said that as a general rule each crop responds differently to different micronutrient deficiencies. For instance, boron deficiency on cotton is expressed by a group of symptoms which are quite different from those exhibited on apples, on beets, or on pines. We no doubt have micronutrient troubles which have not yet been identified as such and are probably attributed to other or unknown causes.

Sometimes difficulties have been experienced in correcting the troubles even after they have been clearly identified. More definite knowledge is needed as to which micronutrient is lacking in any particular soil, and in what region of the soil, which crops are more affected than others under given conditions, what are the symptoms of each element deficiency on each crop, and most of all, what is the most effective and economical way to correct the condition. Failures to correct the trouble by spraying micronutrient solutions on the foliage of some valuable ornamental plants have been encountered. These may be attributed to various factors such as the low absorptive qualities of the tissues, the age of the plant, unfavorable atmospheric conditions, thickness of the cuticle and other morphological structures, and perhaps to other causes. In some instances adding micronutrients to the soil has not corrected the trouble. Since some of these trace elements are toxic in nature, an oversupply of them would be dangerous.

The bulletin describes a chlorotic condition of the cantaloupe crop as it develops in the field, its causes, and the means by which it was completely corrected. In addition a relation between the incidence of this trouble and the subsoil profile was studied, and in this connection, a theory is proposed to explain the curious manner of development of this micronutrient disease in the field, the eventual complete and natural recovery of some plants and not of others, and the basis on which the incidence of this and perhaps other micronutrient diseases may be sometime explained.

This abnormal and injurious condition of cantaloupe vines has been observed for a long time in Mississippi. It has often caused considerable losses to the crop, some annoyance to growers and much puzzlement about its cause. The nutritional disease is expressed from the beginning by yellowing of the foliage, slow growth, and stunting of the vines. In severe cases, which are quite frequent, the leaf color is straw yellow to sulphur yellow with some burning along the edges. In some cases, the stunted plants wither and die before any fruit is set. In other instances, with less severe chlorosis, the vines show a very gradual greening up followed by a remarkably quick growth and recovery. In most cases, however, the crop will be considerably delayed.

Not all the vines in a given plot area are uniformly affected. Some are very discolored and severely stunted, others are noticeably chlorotic but show some slow growth, while still others may be healthy, vigorous, and normal in every way. The trouble has been seen in most localities in Mississippi where cantaloupes are grown and particularly on light sandy soils which are really the best for cantaloupe growing, all other conditions being favorable. It has been observed on many commercial varieties grown, but not on certain hybrids, thus indicating that perhaps some kind of resistance to it is available. The condition has been closely observed on Experiment Station plots at State College, on a number of private farms and in gardens of the county. Complaints by growers have been frequent and many unsuccessful attempts have been made to correct the trouble by application of commercial fertilizers.

In the spring of 1963 this chlorotic condition appeared on a valuable planting of cantaloupes made for a special purpose in an isolated private garden near Mississippi State University. The plot comprised about ten thousand square feet, was well fertilized with 5-10-5 commercial fertilizer and was planted in the usual manner with one variety each of cantaloupes and watermelons. Abundant rains fell after planting. The topsoil was Shubuta fine sandy loam deep alluvial surface phase, with pH 5.7. The trouble was noticed on a great many cantaloupe plants soon after emergence. As usual some of them were severely affected, others less so, and still others looked normal. The most severely chlorotic plants were on soil of lighter color, and the best looking plants were on a section of the plot with darker soil. All the watermelon vines looked normal and produced a heavy early crop.

Assuming this time that a deficiency of one or more microelements in the tissue or in the soil, perhaps brought about by leaching or by chemical inactivation, might be the cause of the failure of the cantaloupe plants to grow normally, a foliage spray experiment was undertaken whereby each vine was supplied with one only of the following micronutrients: boron, copper, iron, magnesium, manganese, molybdenum and zinc. All of the compounds were of the highest available purity. Also included were calcium nitrate and a mixture of nitrogen, phosphorus and potassium salts.

Sixty-five of the most severely chlorotic vines were selected for the test, most of which did not measure more than 14 inches across. Partly chlorotic vines were omitted from the test. Each microelement was applied on 5 different vines scattered at random throughout the experimental block, each vine constituting a replication. For checks, ten vines were sprayed with distilled water, and ten other vines not sprayed. Additional checks were provided by applying commercial fertilizer, 5-10-5, as dust around some of the vines.

Two spray applications were made, using a 100 cc capacity hand sprayer, the first application when the plants were seven weeks old, the second about a week later. Each vine was sprayed uniformly and carefully, in an effort to avoid drifts, and received approximately 10 cc of the solution each time, some of which dripped to the ground. After spraying five plants with one solution, the sprayer was thoroughly washed before using it again with another solution in order to avoid any mixing of chemical elements. Records on recovery from chlorosis and amount of growth of the vines were taken two weeks after the first spray application. A heavy rain and then light intermittent showers preceeded the first spray application and more showers fell between the two applications.

Table 1 shows the results of the trials. They may be summarized as follows: The best recovery from chlorosis was effected by sodium molybdate and zinc sulphate. The results were striking. All the replications showed a dark green color, many buds and sprouts, and the vines had increased in size many times in the short interval between first spray applications and record taking. The vines commenced to set fruit and eventually produced a fairly good harvest of good

Table 1. Results showing degree of recovery from severe non-infectious chlorosis of cantaloupe vines following spray applications with different microelements. Two spray applications were made at one-week interval, seven weeks after planting. Each plant received about 10cc of the spray material at each application.

Solution sprayed on plants	Order of application	Concentration %	Rating[1]
Sodium molybdate	7	0.1	4.0
Zinc sulphate	8	0.1	4.0
Boric acid	2	0.1	3.2
Calcium nitrate	9	0.5	2.6
Manganese sulphate	6	0.1	0.6
N-P-K	10	1.5	0.6
Copper sulphate	3	0.1	0.4
Magnesium sulphate	5	0.1	0.2
Distilled water	1	0.0	0.1
Iron sulphate	4	0.1	0.0
None	----	—	0.0

[1] Legend—Extent of green matter on leaves (recorded two weeks after first spray application) was accompanied by a corresponding growth of vines and was recorded as follows:

0—Plants completely chlorotic with some necrosis (burning) along the leaf edges. No recovery or fresh growth noted.

1—Slight greening of leaves and some growth noticable.

2—Plants show some growth but also show signs of chlorosis.

3—Plants almost normal green and showing considerable growth.

4—Vines very green, color normal. Increase of growth several times the original size.

quality cantaloupes. There was good recovery from chlorosis by the application of boric acid, also, the effects resembling closely those of molybdenum and zinc, the vines becoming green and very enlarged (see legend under Table 1). The other elements, such as copper, iron, magnesium and manganese, produced either no change or only insignificant beneficial effects, except calcium nitrate, which induced a recovery below that of boric acid. It is interesting to note that the chlorotic plants were unable to utilize potassium, phosphorus, and nitrogen when applied to the surface of foliage, under the conditions of the trials. Nor were beneficial effects noted from applying the commercial fertilizer mixed with the soil. The plants remained unresponsive as did all the untreated checks.

In addition to the spray experiments described above, some investigations were made on the contour of the subsoil in regard to the position of chlorotic and non-chlorotic plants above it. In previous studies made elsewhere concerning abnormal stunted growth of crops like lettuce, beets, carrots, and flax grown under irrigation, a high positive correlation was found between the size of the plants and their nearness to the clay subsoil. The very stunted plants were situated from about 20 to 36 inches away from the subsoil below, while the largest and tallest plants, growing nearby in the same row, were only 5 to 8 inches above the clay subsoil level. The undulating line of the crop seemed to parallel the undulating profile of the subsoil. The roots of the largest plants seemed to have reached the subsoil quickly, being nearest to it, and were in close touch with it, while the roots of the stunted plants were still within the sandy topsoil area, some distance from the clay area. Adding various combinations of commercial N, P and K fertilizers did not correct the situation and the problem was left unsolved. It did not occur to this investigator then that the trouble may have been that of minor element deficiency, and consequently no such nutrients were tried.

In the case of the present problem with cantaloupes, borings were made with a soil auger directly under the chlorotic plants and under those other plants in the same area which had shown normal green color from the very start. It was found that the subsoil under the normal plants was nearer to them than was the subsoil under the chlorotic plants. In borings under eight non-chlorotic plants, the clay subsoil stood at a distance from the sandy surface of about 12 to 14 inches, while under the chlorotic plants on the other hand, in eight other borings, the clay was located deeper, some 21 to 24 inches below the topsoil surface. It seemed from these tests that the subsoil layer did not have a regular horizontal surface but represented more or less an undulated profile, some points of which were closer to the emerging plants than others.

Chemical analyses were made of the topsoil and subsoil some time after harvest. The topsoil contained 184 lbs. of P_2O_5 per acre, while the subsoil had 150 lbs. per acre. The exchangeable potassium was 256 and 291 lbs., respectively. Calcium was sufficient and magnesium high in all samples.

Organic matter was low in both soil layers, varying from 1.45% for the topsoil to 1.01% for the subsoil. There were not great differences in the major nutrients or in organic matter content between the lighter sandy soil where most of the chlorotic plants grew and the darker colored sandy soil where many of the healthy plants were found. The difference in color probably was due to the larger amount of clay in the darker soil.

All the above circumstances may be considered in formulating an answer to some puzzling questions. The following questions may be asked:

Why in the same field do some plants develop chlorosis while their neighbors remain healthy? Why did zinc alone produce complete recovery of the chlorotic plants without the aid of molybdenum or of any other essential elements? And the reverse question may also be asked, why did molybdenum alone produce the same satisfactory results as zinc without the aid of the other elements, zinc and boron, which likewise, each alone, induced marked color changes and growth of the sprayed plants?

These questions may be examined within the context of a simple theory. First, it may be assumed that none of the essential elements are available in sufficient amounts in the topsoil, having been leached out, or tied up by phosphorus, or inactivated by certain physical conditions, waterlogging, etc. Second, it may also be assumed that all of the needed essential microelements are present and available in sufficient quantities in the subsoil, perhaps in the upper transition layers, which may serve as depository for these vital nutrients. To these two assumptions should be added the fact already demonstrated, that the subsoil profile or contour is undulating in outline and not level or smoothly inclined. In other words, the clayish subsoil surface, even though not closely delineated, represents numerous small "craters," "hills," and "valleys" of different heights and depths.

Because of the above circumstance, real or plausible, the roots of some plants whether sprayed or not, will reach the subsoil surface more quickly than others, which will enable them to continue to live and develop by absorbing the various microelements needed, perhaps all of which are lodged in or in the neighborhood of the subsoil. Such plants will have a normal growth and will quickly spread their roots in all directions.

On the other hand, other plants whose roots happened to be as far away from the sustaining subsoil as 20 or more inches may seem to have exhausted their life energy before reaching the level of the essential microelements. But if such plants, before they actually die are supplied with one single micronutrient, which will act as a stimulus, then they will continue their growth, albeit slowly, until their roots reach the neighborhood of the subsoil where they are likely to encounter a very favorable nutrient environment, including the rest of the micronutrients and also the accumulated N, P and K, after rains had leached them down through the sandy topsoil. The result would be a burgeoning of growth of the plants as observed.

This interpretation points to parts of the subsoil and to the transitional soil zone as important sources of micronutrients. It has been observed by workers in California (2) that deep cultivation, 21 inches or more, has lessened the severity of deficiency symptoms in cotton, and suggested that this resulted from better root development. In addition, it may now be suggested that deep cultivation or plowing will tend to break up the undulating profile of the subsoil and also bring up more clay particles containing micronutrients into the topsoil.

The role of phosphorus in the ability to bind zinc should not be overlooked in interpreting microelement deficiency problems, particularly in cases where this mineral had been applied to the soil in large quantities (3).

This work needs to be continued, in order to find the most effective, economic ways of applying the microelements to this crop. It is well known that with some crops, molybdenum may be applied as a seed treatment.

The subject of micronutrients as catalysts or reaction regulators offers a very interesting and rewarding field for basic research which should be exploited with intensity and alacrity. New deficiency diseases are being discovered continually, a fact testifying perhaps to the incomprehensive knowledge existing about them. In contributing to the normal growth of plants, micronutrients also contribute to the better and greater utilization of the major elements, N, P, and K. We are yet to assess properly the potential magnitude and prominence the minor elements may assume by reducing the per-acre cost of production of many crops in this country, and by increasing general agricultural prosperity throughout the world.

Summary

A micronutritional disease on cantaloupe vines, frequently encountered in Mississippi, is described. The vines turn yellow from the start; some die; others eventually may recover. Fertilizing such vines with commercial fertilizers containing N, P, and K has been of no help. On the other hand, the trouble was completely corrected by spraying the chlorotic vines with 0.1 percent solution of zinc sulphate, or of sodium molybdate, or of boric acid. Each of these compounds, applied alone, induced a quick recovery of the green color of the foliage and stimulated an unusually rapid growth of the vines.

In the field some plants develop the chlorosis, while their neighbors remain healthy. This is associated with the fact that the subsoil, which probably contains all the micronutrients necessary for normal plant growth, is undulating in outline. Thus plants growing over deep topsoil, lacking available micronutrients, fail to reach the subsoil and consequently develop the chlorosis, while those plants situated closer to the subsoil make the vital contact and develop normally.

The above circumstances may also help to explain why this micronutrient deficiency trouble may be corrected by any of the three elments—zinc, molybdenum, or boron—and why recovering plants eventually burst forth in vigorous growth. When one needed micronutrient is applied to the foliage of a dying chlorotic plant, this acts as a stimulus, enabling the roots to reach down to the pockets and the recesses of the sustaining subsoil, where the other needed micronutrients are assumed to be found, together with the accumulated N, P, and K. After this a burgeoning begins, resulting in a very green and vigorous plant.

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Power and Equipment Costs in the Brown Loam Area of Mississippi

By

Thomas E. Tramel and James T. Long

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POWER AND EQUIPMENT COSTS IN THE BROWN LOAM AREA OF MISSISSIPPI

Thomas E. Tramel and James T. Long

INTRODUCTION

As power and equipment are substituted for labor, the cost of these items form a larger and larger part of farm expenses. Thus power and equipment costs are becoming more and more important considerations in planning the most profitable organization of Mississippi farms. This study was made for the purpose of determining the costs incurred by farmers in the Brown Loam Area of Mississippi in the operation of the major items of farm power and equipment.

METHOD OF STUDY

Three counties — one in the Northern, one in the Central, and one in the Southern part of the area — were selected as representative of the Brown Loam Area. Each of the three counties was then divided into sub-areas and approximately one-third of the sub-areas selected as "study areas." All farmers within each of the "study areas" who used tractors and related equipment were interviewed. Information relative to costs associated with power and equipment and amount of annual use was obtained from 212 farmers in the three counties.

In addition to information obtained from farmers, certain information from the **Agricultural Engineers' Handbook**[1] was used in calculating power and equipment costs. This book reports the averaged hours required for the different items of power and equipment to "wear out" as well as the number of years for the different items of power and equipment to become obsolete if not worn out. These data were used in calculating depreciation as indicated below.

Depreciation: In calculating depreciation, the average amount of annual use by farmers in the area was calculated. The number of years required to wear out the item of power and equipment with this amount of annual use was then determined. Years of useful life of specific equipment were assumed to be the lesser of either the calculated number of years the equipment would last with average use or the number of years required for obsolescense. Due to the small size of most of the farms in the Brown Loam Area, and the resulting low level of annual use, the number of years for obsolescense was used in most instances. The cost of replacing the item of power or equipment at 1962 prices was depreciated over the number of years involved.

Interest on investment: Throughout the life of an item of power or equipment, the average investment in the item is about one-half the original cost. For purposes of this study interest on investment was calculated at six percent on one-half the cost of replacing the item at 1962 prices.

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[1] Richey, C. B., **Agricultural Engineers' Handbook**, McGraw-Hill Book Company, Inc., New York, 1961.

Repairs: Costs of minor repairs were considered as an annual expense. Major overhauls, tires, and batteries were estimated to last longer than a year. (See Appendix Table 3). The costs of these three items were prorated over their estimated life spans. In all cases repair costs are based on costs reported by the farmers interviewed.

Fuel: Since fuel costs depend upon the implement being used with the tractor, tractor fuel costs were estimated separately for the different items of equipment. Farmer estimates were used in determining the amount of fuel required when using the different items of equipment.

Performance rates: In determining power and equipment costs per acre, the time required to cover an acre must be known. Performance rates are based upon estimates provided by the farmers interviewed.

REPORTED COSTS

Power and equipment costs calculated in the manner indicated above are reported in the tables below. Tractor costs are presented in Table 1, equipment costs in Table 2, fuel costs in Table 3, total costs per acre for the tractor, fuel, and equipment in Table 4 and truck costs in Table 5. These costs are based on the actual use made of the items of power and equipment. Since for most items "years required for obsolescense" rather than "hours required to wear out" was used in calculating depreciation, fixed costs could be reduced by more intensive use.

Table 1. Tractor costs excluding fuel, Brown Loam Area, Mississippi, 1962.

Item	Size		
	1-row	2-row	4-row
Annual fixed cost:			
Depreciation	$136.67	$200.13	$295.00
Interest	61.50	90.06	106.20
Total	$198.17	$290.19	$401.20
Annual variable cost:			
Repairs	$ 70.10	$109.34	$210.03
Tires	17.96	35.12	61.35
Lubricants	12.76	25.33	26.82
Total	$100.82	$169.79	$298.20
Total annual cost	$298.99	$459.98	$699.40
Annual use (hrs.)	489	762	936
Fixed cost per hr.	$ .41	$ .38	$ .43
Variable cost per hr.	.21	.22	.32
Total cost per hr.	$ .62	$ .60	$ .75

Table 2a. Equipment costs, Brown Loam Area, Mississippi, 1962.

Item	Implement							
	Ammonia applicator 2-row[A]	Breaking plow			Combine		Corn-Picker	
		1-row	2-row	4-row	Pull type	Self-propelled	1-row	2-row
Annual fixed cost:								
Depreciation	$70.00[B]	$ 11.67	$ 17.13	$ 19.47	$217.90	$612.50	$115.40	$321.88
Interest	21.00	5.25	7.71	8.76	65.37	183.75	34.62	77.25
Total	$ 91.00	$ 16.92	$ 24.84	$ 28.23	$283.27	$796.25	$150.02	$399.13
Annual variable cost:								
Repairs	$ 30.60	$ 2.75	$ 8.40	$ 43.33	$ 60.77	$223.09[C]	$ 49.62	$ 80.83
Grease	2.40	.91	1.42	4.32	6.41	9.00	3.91	7.44
Total	$ 33.00	$ 3.66	$ 9.82	$ 47.65	$ 67.18	$232.09	$ 53.53	$ 88.27
Annual use (hrs.)	55	92	58	85	75	74	87	186
Annual use (acres)	175	46	58	127	75	177	61	186
Acres per hour	3.2	.5	1.0	1.5	1.0	2.4	.7	1.0
Fixed cost per hr.	$ 1.65	$ .18	$ .43	$ .33	$ 3.78	$ 10.76	$ 1.72	$ 2.15
Variable cost per hr.	.60	.04	.17	.56	.90	3.14	.62	.47
Total cost per hr.	$ 2.25	$ .22	$ .60	$ .89	$ 4.68	$ 13.90	$ 2.34	$ 2.62
Fixed cost per acre	$ .52	$ .37	$ .43	$ .22	$ 3.78	$ 4.50	$ 2.46	$ 2.15
Variable cost per acre	.19	.08	.17	.38	.90	1.31	.88	.47
Total cost per acre	$ .71	$ .45	$ .60	$ .60	$ 4.68	$ 5.81	$ 3.34	$ 2.62

Table 2b. Equipment costs, Brown Loam Area, Mississippi, 1962.

	Implement							
			Cultivator			Disc		
Item	Cotton picker 1-row	Culti-packer 2-row	1-row	2-row	4-row	1-row	2-row	4-row
Annual fixed cost:								
Depreciation	$1000.00	$ 12.80	$ 14.58	$ 22.17	$119.50	$ 13.00	$ 19.75	$ 54.88
Interest	300.00	7.68	5.25	7.98	28.68	7.80	11.85	26.34
Total	$1300.00	$ 20.48	$ 19.83	$ 30.15	$148.18	$ 20.80	$ 31.60	$ 81.22
Annual variable cost:								
Repairs	$ 362.50	$ 5.23	$ 4.50	$ 13.19	$ 70.00	$ 3.33	$ 17.15	$ 63.33
Grease	17.04	1.32	1.20	1.70	2.52	1.87	5.11	6.84
Total	$ 379.54	$ 6.55	$ 5.70	$ 14.89	$ 72.52	$ 5.20	$ 22.26	$ 70.17
Annual use (hrs.)	207	39	169	158	321	58	53	124
Annual use (acres)	124	112	135	301	1350	46	84	347
Acres per hour	.6	2.9	.8	1.9	4.2	.8	1.6	2.8
Fixed cost per hr.	$ 6.28	$ .53	$ .12	$ .19	$ .46	$ .36	$ .60	$ .66
Variable cost per hr.	1.83	.17	.03	.09	.23	.09	.42	.57
Total cost per hr.	$ 8.11	$ .70	$ .15	$ .28	$ .69	$ .45	$ 1.02	$ 1.23
Fixed cost per acre	$ 10.48	$ .18	$ .15	$ .10	$ .11	$ .45	$ .38	$ .23
Variable cost per acre	3.06	.06	.04	.05	.05	.11	.26	.20
Total cost per acre	$ 13.54	$ .24	$ .19	$ .15	$ .16	$ .56	$ .64	$ .43

Table 2c. Equipment costs, Brown Loam Area, Mississippi, 1962.

	Implement							
					Harrows			
Item	Flame cultivator 4-row	Forage harvester	Front end loaders	Grain drill	1-row	2-row	4-row	Hay baler
Annual fixed cost:								
Depreciation	$ 55.00	$158.33	$ 17.93	$ 26.45	$ 6.50	$ 7.10	$ 12.70	$187.92
Interest	16.50	57.00	8.07	15.87	3.90	4.26	7.62	67.65
Total	$ 71.50	$215.33	$ 26.00	$ 42.32	$ 10.40	$ 11.36	$ 20.32	$255.57
Annual variable cost:								
Repairs	$ 10.00	$ 3.00	$ 3.34	$ 17.56	$ 1.00	$ 1.93	$ 14.29	$ 75.16
Grease	XX	4.63	2.40	2.30	XX	XX	XX	5.76
Total	$ 10.00	$ 7.63	$ 5.74	$ 19.86	$ 1.00	$ 1.93	$ 14.29	$ 80.92
Annual use (hrs.)	90	72	60	40	38	31	63	95
Annual use (acres)	225	36	XX	103	76	100	295	124
Acres per hour	2.5	.5	XX	2.6	2.0	3.2	4.7	1.3
Fixed cost per hr.	$ .79	$ 2.99	$ .43	$ 1.06	$ .27	$ .37	$ .32	$ 2.69
Variable cost per hr.	.11	.11	.10	.50	.03	.06	.23	.85
Total cost per hr.	$ .90	$ 3.10	$ .53	$ 1.56	$ .30	$ .43	$ .55	$ 3.54
Fixed cost per acre	$ .32	$ 5.98	$ XX	$ .41	$ .15	$ .11	$ .07	$ 2.06
Variable cost per acre	.04	.21	XX	.19	.01	.02	.05	.65
Total cost per acre	$ .36	$ 6.19	$ XX	$ .60	$ .16	$ .13	$ .12	$ 2.71

Table 2d. Equipment costs, Brown Loam Area, Mississippi, 1962.

	Implement							
			Mower		Planter			
Item	Highboy 6-row[A]	Middle breaker, 2-row	Rotary	Sickle	1-row	2-row	4-row	Post emerge shoe 2-row
Annual fixed cost:								
Depreciation	$176.70	$ 17.80	$ 36.08	$ 28.42	$ 8.35	$ 14.10	$ 53.81	$ 9.20
Interest	53.01	8.01	12.99	10.23	5.01	8.46	25.83	2.76
Total	$229.71	$ 25.81	$ 49.07	$ 38.65	$ 13.36	$ 22.56	$ 79.64	$ 11.96
Annual variable cost:								
Repairs	$ 54.82[C]	$ 5.71	$ 20.98	$ 29.13	$ 10.00	$ 13.49	$ 26.67	$ 8.25
Grease	7.20	.58	4.06	2.98	1.39	1.85	3.24	XX
Total	$ 62.02	$ 6.29	$ 25.04	$ 32.11	$ 11.39	$ 15.34	$ 29.91	$ 8.25
Annual use (hrs)	77	38	111	53	50	39	75	44
Annual Use (acres)	345	65	256	106	35	71	300	88
Acres per hour	4.5	1.7	2.3	2.0	.7	1.8	4.0	2.0
Fixed cost per hr.	$ 2.98	$ .68	$ .44	$ .73	$ .27	$ .58	$ 1.06	$ .27
Variable cost per hr.	.81	.17	.23	.61	.23	.39	.40	.19
Total cost per hr.	$ 3.79	$ .85	$ .67	$ 1.34	$ .50	$ .97	$ 1.46	$ .46
Fixed cost per acre	$ .67	$ .40	$ .19	$ .36	$ .38	$ .32	$ .27	$ .14
Variable cost per acre	.18	.10	.10	.30	.33	.22	.10	.09
Total cost per acre	$ .85	$ .50	$ .29	$ .66	$ .71	$ .54	$ .37	$ .23

Table 2e. Equipment costs, Brown Loam Area, Mississippi, 1962.

Item	Implement						
	Rake, side delivery	Rotary-hoe, 2-row	Sprayer, 6-row	Stark shredder 2-row	Sub-soiler, 1-chisel	Trailer	
						2-w	4-w
Annual fixed cost:							
Depreciation	$ 30.47	$ 15.40	$ 24.00	$ 35.90	$ 9.47	$ 7.13	$ 20.93
Interest	13.71	6.93	7.20	10.77	4.26	3.21	9.42
Total	$ 44.18	$ 22.33	$ 31.20	$ 46.67	$ 13.73	$ 10.34	$ 30.35
Annual variable cost:							
Repairs	$ 32.27	$ 4.88	$ 14.44	$ 15.85	$ XX	$ 5.67	$ 15.24
Grease	2.23	.94	1.22	2.98	XX	.62	.77
Total	$ 34.50	$ 5.82	$ 15.66	$ 18.83	$ XX	$ 6.29	$ 16.01
Annual use (hrs.)	42	32	93	81	28	100	160
Annual use (acres)	127	93	417	170	33	XX	XX
Acres per hour	3.0	2.9	4.5	2.1	1.2	XX	XX
Fixed cost per hr.	$ 1.05	$ .70	$ .34	$ .58	$ .49	$ .10	$ .19
Variable cost per hr.	.82	.18	.17	.23	XX	.06	.10
Total cost per hr.	$ 1.87	$ .88	$ .51	$ .81	$ .49	$ .16	$ .29
Fixed cost per acre	$ .35	$ .24	$ .07	$ .27	$ .42	$ XX	$ XX
Variable cost per acre	.27	.06	.04	.11	XX	XX	XX
Total cost per acre	$ .62	$ .30	$ .11	$ .38	$ .42	$ XX	$ XX

[A] Does not include cost of chemical to be applied.

[B] Does not include depreciation for ammonia storage tank.

[C] Includes charges for maintenance of power plant.

Table 3. Fuel cost per hour for operating one-, two-, and four-row tractors with specified farm equipment, Brown Loam Area, Mississippi, 1962.[A]

Item	Tractor size		
	One-row	Two-row	Four-row
Ammonia applicator	- -	.53	- -
Breaking plow	.34	.53	.87
Combine (pull type)	- -	.64	- -
Corn picker	.66	.74	- -
Cotton picker[B]	- -	.58	- -
Cultipacker	- -	.40	- -
Cultivator	.32	.45	.85
Disc	.32	.50	.98
Flame cultivator[C]	- -	- -	.53
Forage harvester	- -	.66	- -
Front-end loader	- -	.40	- -
Grain drill	- -	.48	- -
Harrow	.27	.40	.53
Hay baler	- -	.58	- -
Middle breaker	- -	.48	- -
Mower (rotary)	- -	.42	- -
Mower (sickle)	- -	.40	- -
Planter	.24	.37	.64
Post emerge shoe	- -	.40	- -
Rake (side delivery)	- -	.40	- -
Rotary hoe	- -	.37	- -
Spray equipment[D]	- -	.37	- -
Stalk shredder	- -	.42	- -
Subsoiler (1-chisel)	- -	.69	- -
Trailer (2-w)	- -	.32	- -
Trailer (4-w)	- -	.40	- -
Other[E]	- -	- -	- -

[A] Fuel costs @ $.265 per gal.

[B] One-row, mounted.

[C] Fuel for power only.

[D] 6-row capacity.

[E] Self-propelled combine, $.78 per hour. Fuel for flame computed @ 3.0 gals. per hr. @ $.125 per gal. Highboy spray-rig, $.37 per hour.

Table 4. Tractor, fuel, and implement cost per acre, Brown Loam Area, Mississippi, 1962.[A]

Item	Cost			
	Implement	Tractor	Fuel	Total
Ammonia applicator (2-r)	.71	.19	.17	1.07
Breaking plow (1-r)	.45	1.24	.68	2.37
Breaking plow (2-r)	.60	.60	.53	1.73
Breaking plow (4-r)	.60	.50	.58	1.68
Combine (pull-type)	4.68	.60	.64	5.92
Combine (self-propelled)	5.81	- -	.32	6.13
Cornpicker (1-r)	3.34	.86	.94	5.14
Cornpicker (2-r)	2.62	.60	.74	3.96
Cottonpicker (1-r)	13.54	1.00	.97	15.51
Cultipacker (2-r)	.24	.21	.13	.58
Cultivator (1-r)	.19	.78	.40	1.37
Cultivator (2-r)	.15	.32	.24	.71
Cultivator (4-r)	.16	.18	.20	.54
Disc (1-r)	.56	.78	.40	1.74
Disc (2-r)	.64	.38	.31	1.33
Disc (4-r)	.43	.27	.35	1.05
Flame cultivator (4-r)	.36	.30	.36[B]	1.02
Forage harvester	6.19	1.20	1.32	8.71
Grain drill	.60	.23	.18	1.01
Harrows (1-r)	.15	.31	.14	.60
Harrows (2-r)	.13	.19	.12	.44
Harrows (4-r)	.12	.13	.11	.36
Hay baler	2.71	.46	.45	3.62
Highboy	.85	- -	.08	.93
Middlebreaker (2-r)	.50	.35	.28	1.13
Mower (rotary)	.29	.26	.18	.73
Mower (sickle)	.66	.30	.20	1.16
Planter (1-r)	.71	.89	.34	1.94
Planter (2-r)	.54	.33	.21	1.08
Planter (4-r)	.37	.19	.16	.72
Post emerge shoe (2-r)	.23	.30	.20	.73
Rake (side delivery)	.62	.20	.13	.95
Rotary-hoe (2-r)	.30	.21	.13	.64
Sprayer (6-r)	.11	.13	.08	.32
Stalk shredder (2-r)	.38	.29	.20	.87
Subsoiler (1-chisel)	.42	.50	.58	1.50

[A] Tractor and fuel costs calculated on the basis of the size tractor usually used with each item of equipment.

[B] Includes fuel for flame at $.15 per acre.

Table 5. Truck costs, Brown Loam Area, Mississippi, 1962.

	Size	
Item	Light[A]	Heavy[B]
Annual fixed cost:		
Depreciation	$206.20	$241.17
Interest	61.86	86.82
Total	$268.06	$327.99
Annual variable cost:		
Repairs	$ 98.65	$121.95
Lubricants	27.91	24.56
Fuel	183.86	171.97
Tires	50.34	90.54
Miscellaneous[C]	73.65	122.44
Total	$434.41	$531.46
Total annual cost	$702.47	$859.45
Annual use (miles)	9,316	6,697
Fixed cost per mile	$ .03	$ .05
Variable cost per mile	.05	.08
Total cost per mile	$ .08	$ .13

[A] 1/2- and 3/4-ton pickups.

[B] Mostly 2-ton capacity but includes approximately equal numbers of 1 1/2- and 2 1/2-ton capacity.

[C] Includes insurance, taxes, and licenses.

Appendix Table 1. Miscellaneous information relative to power and equipment cost, Brown Loam Area, Mississippi, 1962.

Item	Replacement cost	Hrs. to wear out	Yrs. to obsolescence	Annual use	
				Acres	Hrs.
Tractor (1-r)	$ 2,050	12,000	15	- -	481
Tractor (2-r)	3,002	12,000	15	- -	762
Tractor (4-r)	3,540	12,000	15	- -	936
Truck (light)[A]	2,062	100,000 miles	12	- -	9,316 miles
Truck (heavy)[B]	2,894	100,000 miles	12	- -	6,697 miles
Ammonia applicator (2-r)	700	1,500	10	175	55
Ammonia tank (1000 gal.)	750	- -	10	- -	- -
Breaking plow (1-r)	175	2,000	15	46	92
Breaking plow (2-r)	257	2,000	15	58	58
Breaking plow (4-r)	292	2,000	15	127	85
Combine (pull-type)	2,179	2,000	10	75	75
Combine (self-propelled)	6,125	2,000	10	177	74
Corn picker (1-r)	1,154	1,500	10	61	87
Corn picker (2-r)	2,575	1,500	10	186	186
Cotton picker (1-r mounted)	10,000	2,000	10	186	186
Cultipacker (2-r)	256	1,500	20	112	39
Cultivator (1-r)	175	2,500	12	135	169
Cultivator (2-r)	266	2,500	12	301	158
Cultivator (4-r)	956	2,500	12	1,350	321
Disc (1-r)	260	2,000	20	46	58
Disc (2-r)	395	2,000	20	84	53
Disc (4-r)	878	2,000	20	347	124
Flame cultivator (4-r)	550	1,500	10	225	90
Forage harvester	1,900	2,000	12	36	72
Front-end loader	269	2,000	15	- -	60
Grain drill (2-r)	529	1,200	20	103	40
Harrow (1-r)	130	2,500	20	76	38
Harrow (2-r)	142	2,500	20	100	32
Harrow (4-r)	254	2,500	20	295	63
Hay baler (pull-type)	2,255	2,500	12	124	95
High-boy (6-r)	1,767	1,500	10	345	77
Middlebreaker (2-r)	267	2,000	15	65	38
Mower (rotary)	433	2,000	12	256	111
Mower (sickle)	341	2,000	12	106	53
Planter (1-r)	167	1,200	20	35	50
Planter (2-r)	282	1,200	20	71	39
Planter (4-r)	861	1,200	20	300	75
Post emerge shoe (2-r)	92	800	10	88	44
Rake (side delivery)	457	1,500	15	127	42
Rotary hoe (2-r)	231	1,500	15	93	32
Spray equip. (6-r)	240	1,500	10	417	93
Stalk shredder (2-r)	359	2,500	10	170	81
Subsoiler (1-chisel)	142	1,500	15	33	28
Trailer (2-w)	107	5,000	15	- -	100
Trailer (4-w)	314	5,000	15	- -	160

[A] 1/2- and 3/4-ton pickups.

[B] Mostly 2-ton capacity but includes approximately equal numbers of 1 1/2- and 2 1/2-ton capacity.

Appendix Table 2. Costs for fuel and maintenance items, Brown Loam Area, Mississippi, 1962.[A]

		Implement				
		Truck		Tractor		
Item	Unit	Light	Heavy	1-row	2-row	4-row
Oil filter	each	$ 1.85	$ 1.72	$ 1.72	$ 1.46	$ 1.27
Batteries[B]	each	18.79	17.09	15.71	16.50	21.73
Tires (front)[C]	each	21.39	55.12	15.50	19.26	22.22
Tires (rear)[C]	each	27.50	62.98	57.50	78.36	96.66
Major overhaul	each	141.55	200.39	97.50	155.11	282.86
Licenses	yr.	29.55	63.94	- -	- -	- -
Insurance[D]	yr.	44.10	58.50	- -	- -	- -

[A] Cost of other items are as follows: gasoline for trucks, $.29; gasoline for tractors, $.265 per gallon; L. P. fuel, $.125 per gallon; oil for trucks, $.36 per quart; oil for tractors, $.31 per quart; grease, $.24 per pound; and antifreeze, $.61 per quart.

[B] Average price paid for Highboy batteries was $16.50 and for self-propelled combines $17.67.

[C] Cost of tires for other implements calculated as part of annual maintenance.

[D] Includes minimum liability and medical coverage each year with collision the first three years pro-rated over the life of the vehicle.

Appendix Table 3. Estimated years of useful life for selected repair items, Brown Loam Area, Mississippi, 1962.

	Implement				
	Truck		Tractor		
Item	Light	Heavy	1-row	2-row	4-row
Major overhaul	4.3	5.8	4.5	4.6	3.4
Battery[A]	2.4	2.3	2.0	1.9	1.9
Tires (front)	2.0	4.0	7.0	4.5	2.9
Tires (rear)	1.9	4.0	8.5	5.9	4.2

[A] Average battery life for Highboy was 2.5 years and self-propelled combines 2.6 years

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Pilot Plant Processing Studies

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On Cover:

Pilot plant building at Truck Crops Branch Experiment Station, Crystal Springs.

PILOT PLANT PROCESSING STUDIES

By JOHN A. CAMPBELL, W. O. THOMAS, STEVE L. WINDHAM
AND DAN A. AULTMAN

A pilot plant for processing and quick freezing vegetables was installed at the Truck Crops Branch Station and was ready for operation by the spring season of 1962. The plant has been and will be used primarily in studying processing qualities of different varieties, adaptability of varieties to machine harvesting and handling methods, and the effects of various production practices on yield of both fresh and processed product.

The pilot plant was designed to handle the following vegetable crops: snap beans, lima beans, English peas, Southern field peas, broccoli, cauliflower, greens (turnip, mustard, collard and spinach), okra, and squash. With the addition of a few pieces of equipment the plant could handle sweetpotatoes and other root crops.

The plant is equipped with steam and hot water blanchers which are supplied from one of the two 30 H.P. steam boilers. Other machines in the processing lines are of the type used in commercial processing plants.

Packaging and sealing is done by hand and quick freezing is done in a conventional plate freezer at —30° to —40° F. It has a capacity of 320 5½"x4"x1½" packages per 1½ hours. These packages hold from 8 to 12 ounces depending on the crop. The frozen product is stored in a 1000 cu. ft. storage at 0° F.

With present facilities the plant can turn out 1200 to 1500 packages per 8-hour day. This can accommodate larger experimental plots than are normally used to provide a true pilot scale sample.

Results of these studies, which were started in 1962, show the potentials of each crop in terms of yield, quality, and expected income when grown under contract for processing. Findings from these studies have been very useful in feasibility studies for the establishment of vegetable canning and freezing plants in the Central Mississippi area.

Snap Beans

Three varieties of bush snap beans were grown on 1/12 acre plots each in the spring and fall of 1962. Plots were fertilized at the rate of 1,000 pounds 5-10-5 per acre and seed were planted at the rate of 90 pounds per acre on flat prepared seed bed in 20 inch drills. Randox was applied as a spray at the rate of 5 pounds actual material per acre immediately behind seeding as a pre-emerge chemical weed control. Plants were topdressed with 200 pounds of ammonium nitrate per acre when plants were 8 inches tall.

In the spring season the plots were given a once-over harvest simulating the conditions of a machine harvest. Harvesting was done when the greatest percent of pods set on the plants averaged sieve size 4 or below by count. The beans were then put through the processing plant where fresh weight, pod size distribution and processed turn-out determinations were made. They were processed and quick frozen following standard commercial procedures.

Table I shows the results of the spring test. It will be noted that with Wade and Extender varieties there was a considerable break in pod size distribution between sieve 3 or smaller and 5 or larger and that Harvester produced a more favorable pod maturity pattern for mechanical harvest.

Table 1. Yield of fresh and processed beans with pod size distribution of three varieties once-over harvested, Spring 1962.

				Pod size distribution percent					
				by weight			by count		
				sieve			sieve		
Variety	Yield fresh weight lbs. sieve size 4 and below per acre	Pounds frozen per acre	Number 10 oz. pkgs. per acre	3 and Below	4	5 and Above	3 and Below	4	5 and Above
Wade	2050	1275	2440	35.3	21.2	43.5	54.3	17.0	28.7
Extender	1802	1213	2415	22.8	10.4	66.8	45.0	11.0	44.0
Harvester	2313	1606	3200	56.8	24.7	18.5	71.5	15.2	13.3

Table 2. Yield of fresh beans when first harvest is made by hand and the second is once-over with three varieties.

		Yield—lbs. per acre Once-over second harvest	
		Sieve	
Variety	Yield—lbs. per acre Hand picked first harvest	4 and Below	5 and Above
Harvester	2494	4062	890
Extender	2650	1934	510
Wade	2907	1623	634

Because of relatively low yields from the once-over harvest in the spring test, two harvests were made in the fall test. The first was made by hand and the second harvest was made as a once-over machine harvest. The same determinations were made as in the spring. Table 2 shows the yield for the two methods of harvesting. The results indicate that a much greater total yield can be obtained with two harvests and that a much more favorable maturity and size distribution of pods can be had in a once-over harvest when it is preceded by one hand picked harvest.

Lima Beans

Four varieties of bush lima beans were planted in the spring and fall of 1962 and 1963 on 1/11 acre plots each. The plots were fertilized with 1600 pounds of 5-10-5 per acre and seeded at the rate of 90 pounds seed per acre in drills 20 inches apart on flat seed beds. Vegedex was applied as a spray behind seeders as a pre-emerge chemical weed control at the rate of 6 pounds of actual material per acre. The varieties were topdressed with 200 pounds of ammonium nitrate per acre when plants were about 8 inches tall.

Each variety was once-over harvested when 3 to 5 percent of pods begin to turn yellow and the highest percent of total set was considered usable. This was done by pulling the vines and picking the pods by hand simulating machine harvest. The beans were then put through the processing plant where fresh weight, shelled weight, percent shell-out and yield of processed product were determined. The beans were processed and quick frozen using standard commercial procedures.

Results of the spring test of 1962 are shown in Table 3. Early Thorogreen produced the greatest yield of fresh pods as well as shelled weight per acre. Jackson Wonder, a speckled seeded variety, had the highest percent shellout and was second highest yielder of shelled beans. This variety apparently had less shrinkage due to blanching than other varieties as it turned out the greatest yield of processed product. This test was repeated in the fall of 1962 with the planting made August 20. The crop grew off well

After blanching beans go through this washer.

but when pods began to mature in October temperatures became progressively cooler thus slowing maturity to the point that yields, when made before the first freeze, were too low to report here. This indicated that fall planting date should be made at an earlier date.

In the Spring of 1963 only three varieties were included in the test. Dixie Butterpea, a plump speckled seeded baby lima was added. Table 4 shows that the Dixie Butterpea produced the greatest yield of fresh, shelled and processed yield. The percentage shellout was excellent on all varieties.

The fall trial was planted August 5 or two weeks earlier than the 1962 fall planting. The same varieties that were used in 1962 were used in the 1963 fall trial with the addition of Dixie Butterpea. Table 4 also gives the results of this trial. It is readily apparent that while yield of fresh pods were high for all varieties, the shellout percentages were low due to immaturity caused by progressively lower temperatures during the period of pod maturation before harvest and the first freeze. Results of the two fall seasons show that for best fall production lima beans should be planted on or about July 20 to 25 to allow sufficient time for proper maturing of beans before the first killing frost.

English Peas

Four English pea varieties of the processing type were grown on 1/8 acre plots each in the spring of 1962. Plots were fertilized with 1500 pounds of 5-10-5 per acre and the peas were seeded in drills 12 inches apart on flat prepared seedbed at the rate of 112 pounds per acre on February 3. No chemical weed control or cultivation was required. All varieties were topdressed with 200 pounds of ammonium nitrate per acre when

Table 3. Once-over harvest yields of four varieties of bush lima beans, Spring 1962.

Variety*	Fresh weight lbs. pods per acre	Pounds shelled beans per acre	Percent shellout	Pounds frozen beans per acre	Number 12 oz. packages per acre
Early Thorogreen	7150	2821	39.4	2689	3586
Clark's Bush	5863	2134	36.3	2021	2695
Thaxter	6682	2586	38.4	2557	3410
Jackson Wonder (speckled)	6468	2706	41.8	2780	3707

*Seed furnished by Asgrow.

Table 4. Once-over harvest studies with varieties of bush lima beans.

Variety	Fresh weight lbs. pods per acre	Pounds shelled beans per acre	Percent shellout	Number 12 oz. packages per acre
		Spring, 1963		
Henderson bush	4146	2007	42.2	2710
Jackson Wonder (speckled)	7102	3010	42.3	4353
Dixie butterpea (speckled)	9100	3993	43.8	5420
		Fall, 1963		
Jackson Wonder (speckled)	7774	2386	30.6	3413
Early Thorogreen	7283	2030	27.8	2923
Clark's Bush	8121	1975	24.3	2678
Thaxter	9259	1793	19.3	2409
Dixie Butterpea (speckled)	9396	2236	23.7	3036

Table 5. Once-over harvest processing study with four varieties of English peas — 196

Variety*	Fresh Weight pounds of pods per acre	Pounds shelled peas per acre	Percent shellout	Pounds frozen peas per acre	Number 12 oz. packages per acre
Freezer 626	12065	5517	45.7	4995	6660
Freezer 640	6068	2158	35.5	1877	2727
Freezer 69	7145	2853	40.0	2604	3472
Little Marvel	4006	1085	36.9	1075	1365

*Seed furnished by Asgrow.

plants were 8 inches tall. Varieties were once-over harvested when first set pods were at peak maturity—just before turning gray.

Results of these trials are shown in Table 5. It is shown that wide variation exists in productive capacity of varieties and that profitable yields of this crop are possible with certain varieties.

Southern Peas

In preliminary fertility studies for Southern peas large differences were noted for soils which had varying fertility levels. These influences as measured for the variety Pink-eye Purple Hull bus are shown in Table 6. These resul for each location show the average figu for 14 fertilizer treatments replicate four times. The results indicate that u der the conditions of this test the degr of erosion was the factor which seeme to cause the greatest variation in yield With the exception of location No. 1, a soils were approximately equal in sc fertility as measured by soil tests.

The results show that yields can be i creased as much as 80 percent by prop selection of location. The assumption th peas produce as well, or prefer erod

Crew working at okra grading and trimming belt.

Table 6. Influence of soil fertility on Southern peas for processing.

ocation	1	2	3	4	5
il Type	Bude	Providence	Providence	Providence	Bude
H	5.6	5.6	5.8	5.6	5.8
level	L—	M	H+	M	H
level	L	M	M	M	M
osion	Med.	Sev.	Med.	Med.	Sli.
elds					
ds and peas	4340	2780	4160	4200	5000
elled peas	1960	1260	1880	1900	2260
. 12 oz. Packages	2482	1596	2381	2407	2863

w fertility soil, is erroneous. These tests o showed that pounds of peas in hull oduced is a good indication of yields of ozen peas. Observations made indicat- that in instances where percentage ll increased the loss from over matur- (dry) counteracted this increase. Oth- observations as to color and general pearance of peas indicated little or no influence of location on these factors. The yields obtained in these tests when compared to those in other areas where peas are grown for processing are very favorable for production of this crop.

Studies have also been made of many different varieties of Southern peas to determine yield, once-over harvest, and shelling characteristics as well as processing qualities.

Broccoli

During the fall of 1963 Coastal variety of broccoli was grown with plants spaced 6 inches and 18 inches apart on rows 3½ feet apart. Plots were fertilized with 1200 pounds 6-8-8 per acre and sidedressed with 32 pounds of nitrogen per acre. Plots on which plants were spaced 6 inches apart were harvested as a once-over operation, while those spaced 18 inches apart were harvested 4 times. Results of this study are shown in Table 7. These data indicate that close spacing of plants of a uniform maturing variety might make once-over mechanical harvesting of broccoli feasible.

Table 7. Effect of plant spacing and number of harvest on yield of fresh and processed broccoli.

Variety	Spacing between plants	Number harvest	Pounds per acre Total yield	Trim loss and cull	Net Wt.	No. 8 oz. packages per acre
Coastal	6 inch	Once-over	3104	672	2432	4592
Coastal	18 inch	4 harvests	2996	340	2656	4250

Other Vegetables

Other vegetables which have been grown and processed to determine yield and freezing qualities of different varieties include cauliflower, okra, squash and turnip greens. Results of these studies show that these crops can be grown in the area at a profit for processing under prevailing contract prices, and that the quality of the processed product compares favorably to that of competitive areas.

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Equilibrium

Prices And Movement Of Eggs

In the United States for 1958-60 and 1970

By

A. D. SEALE, JR.

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EQUILIBRIUM PRICES AND MOVEMENTS OF EGGS IN THE UNITED STATES FOR 1958-60 AND 1970

By A. D. SEALE, JR.

Growth in population and shifts in population among areas of the United States will result in major shifts in the demand for table eggs. An efficient table egg industry will require that producers and marketing firms adjust their operations to accommodate these shifts in demand.

The purpose of this study was to provide some guidelines for orderly growth and development of the table egg industry in a market in which demand, supply and technology are changing.

The objectives of this study were to:

1. Develop supply estimates by areas for a base and for a projected period.
2. Develop demand estimates by areas, for a base and for a projected period.
3. Estimate the cost of transporting eggs.
4. Evaluate the equilibrium quantities, flows, and prices of eggs for supply-demand conditions in the base period and in the projected period.

The base period used was an average week in 1958-60; the projected period, a week in 1970. In the selection of a base period from which to measure changes, a three year period was deemed long enough to permit considerable adjustments in the egg industry and to average out short-term fluctuations in quantities and prices. All data on prices and cost are expressed in terms of 1958-60 price levels.

All data on supply and demand were reduced to an average week and are expressed in trucklots of 600 cases with 30 dozens of eggs per case. Transporation costs were based on truck rates and are expressed in dollars for trucklot quantities, or 600 cases.

The market for table eggs for purposes of this study was defined as the area composed of the 48 contiguous states. The market was divided into 40 areas each of which was considered to be a producing and marketing area for table eggs. Provisions were made for an additional market for each area to dispose of eggs in processed form.

The text of this report is confined to a summary of the analysis of the situation for the base period, the projected period, and a comparison of the changes between the two. The information shown as equilibrium levels for consumption, prices and movements are based on conditions of perfect competition. These would be the results if all shippers were to ship to the areas offering the highest net prices. Net prices are defined as the retail price less the cost of transportation. These results were computed by reactive programming procedures which considered the demand for eggs in each area, the supply of eggs in each area and the cost of shipping eggs from each area to all areas.

Supplies

The estimated supplies of table eggs for each area for the base and projected period and percentage changes are shown in Table 1 (See Appendix for a discussion of estimating procedure). The indicated changes in supplies for the respective areas suggest the type of adjustments that must be made in facilities for assembling eggs. The largest increases in supplies were indicated for California, New Jersey and Georgia. An increase of 17 trucklots per week was indicated for Mississippi. The largest decreases in trucklots per week were indicated for Texas, Kansas and Oklahoma.

Demand

Demand as used is this report includes three basic parts (1) the quantity consumed, (2) the price paid for the quantity consumed and (3) changes in the quantity consumed that result from changes in the price of eggs. These basic parts of demand are usually expressed mathematically and are referred to as demand functions; these are shown in the Appendix.

Total Consumption: Estimates of consumption by states are not available, however, such estimates were needed for the approach used to estimate demand functions. Total average consumption estimates by areas for the base period and the equilibrium estimates are shown in Table 2. The magnitude of the differences in the two consumption estimates for the

Table 1. Estimated weekly supplies of eggs for consumption, U.S. market-supply areas, 1958-60 average and projected 1970, in 600-case trucklots.

	Supplies		Changes	
Area	1958-60	1970	Amount	Percent
		—Trucklot—		
1. Alabama	92.94	127.76	34.82	37.5
2. Arizona	14.39	18.22	3.83	26.6
3. Arkansas	60.79	60.77	—0.02	0.0
4. California	482.09	707.50	255.41	46.8
5. Colorado	27.56	14.76	—12.80	—46.4
6. Del., Md., D.C.	40.96	24.33	—16.63	40.6
7. Florida	83.79	139.46	55.67	66.4
8. Georgia	128.75	196.67	67.92	52.8
9. Idaho	25.27	24.33	—0.94	—3.7
10. Illinois	241.21	229.66	—11.55	—4.8
11. Indiana	209.50	221.92	12.42	5.9
12. Iowa	433.69	497.19	63.50	14.6
13. Kansas	135.27	88.97	46.30	—34.2
14. Kentucky	83.65	54.56	—29.09	—34.8
15. Louisiana	40.68	45.40	4.72	11.6
16. Michigan	145.94	145.27	—0.67	—0.5
17. Minn.	324.69	354.77	30.08	9.3
18. Miss.	75.74	93.15	17.41	23.0
19. Missouri	155.30	77.88	—77.42	—49.9
20. Montana	19.90	18.02	—1.88	9.4
21. Nebraska	164.00	164.00	0.00	0.0
22. Nevada-Utah	31.80	22.70	—9.10	28.6
23. New England	223.78	250.02	26.24	11.7
24. New Jersey	205.31	310.49	105.18	51.2
25. New Mexico	12.73	11.30	—1.43	11.2
26. New York	184.77	173.26	—11.51	—6.2
27. N.C.	151.30	211.74	60.44	39.9
28. N.D.-S.D.	172.76	196.88	24.12	14.0
29. Ohio	224.02	199.22	—24.80	—11.1
30. Okla.	64.48	10.79	—53.69	—83.3
31. Oregon	53.04	65.56	12.52	23.6
32. Penn.	319.83	383.37	63.54	19.9
33. S.C.	61.49	84.59	23.10	37.6
34. Tenn.	86.39	77.98	—8.41	—9.7
35. Texas	227.03	171.43	—55.60	—24.5
36. Va.	85.95	65.66	—20,29	—23.6
37. Wash.	91.19	108.52	17.33	19.0
38. West Va.	34.34	17.20	—17.14	—49.9
39. Wis.	196.10	183.64	—12.46	—6.4
40. Wyoming	5.76	1.53	—4.23	—73.4
TOTAL	5418.18	5850.47	432.29	7.98

base period is as small as one could expect because of the variations in the methods of estimation (See Appendix for a discussion of estimating procedure).

The changes in the equilibrium consumption levels indicate the nature of the adjustment needed for the efficient handling of eggs at the wholesale and retail levels. The largest increases in consumption levels are indicated for California, Delaware-Maryland-D.C., and Michigan. The largest decreases are indicated for

Table 2. Estimates of weekly egg consumption, by areas, specified periods, in 600-case trucklots.

Area	Original Estimate 1958-60[1]	Equilibrium Estimates[2]		Changes	
		1958-60	1970	Amount	Percent
			—Trucklot—		
1. Alabama	93.46	94.58	89.00	—5.58	—5.9
2. Arizona	35.72	38.69	54.31	15.62	40.4
3. Arkansas	51.52	50.51	37.17	—13.34	—26.4
4. California	457.81	475.79	587.24	111.45	23.4
5. Colorado	52.23	52.67	60.97	8.30	15.8
6. Del., Md., D.C.	102.28	104.39	150.44	46.05	44.1
7. Florida	130.31	135.89	164.74	28.85	21.2
8. Georgia	112.64	115.77	121.71	5.94	5.1
9. Idaho	19.71	19.60	19.37	—.23	—1.2
10. Illinois	282.40	268.55	277.77	9.22	3.4
11. Indiana	131.77	124.69	139.13	14.44	11.6
12. Iowa	78.82	73.79	69.21	—4.58	—6.2
13. Kansas	61.79	58.82	61.11	2.29	3.9
14. Kentucky	88.96	84.60	79.38	—5.22	—6.2
15. Louisiana	91.95	92.59	98.38	5.79	6.3
16. Michigan	226.47	227.39	270.72	43.33	19.1
17. Minn.	96.20	86.89	89.65	2.76	3.2
18. Miss.	62.76	62.14	52.36	—9.78	—15.7
19. Missouri	123.69	117.09	111.17	—5.92	—5.1
20. Montana	20.79	20.28	20.31	.03	0.1
21. Nebraska	41.13	36.45	36.19	—.26	—0.7
22. Nevada-Utah	35.48	36.02	45.34	9.32	25.9
23. New England	245.61	261.27	259.44	—1.83	—0.7
24. New Jersey	140.97	154.93	166.66	11.73	7.6
25. New Mexico	27.69	28.68	32.10	3.42	11.9
26. New York	405.57	429.42	462.40	32.98	7.7
27. N.C.	133.16	133.84	136.64	2.80	2.1
28. N.D.-S.D.	38.40	32.69	32.58	—.11	—0.3
29. Ohio	273.14	264.79	305.82	41.03	15.5
30. Okla	66.80	66.11	54.94	—11.17	—16.9
31. Oregon	54.75	56.83	67.49	10.66	18.8
32. Penn.	274.69	288.20	286.87	—1.33	—0.5
33. S.C.	69.75	71.89	77.41	5.52	7.7
34. Tenn.	101.88	97.85	98.59	.74	0.8
35. Texas	279.84	275.41	303.82	28.41	10.3
36. Va.	115.38	114.27	114.05	—.22	—0.2
37. Wash.	86.21	91.48	104.57	13.09	14.3
38. West Va.	57.64	58.87	54.30	—4.57	—7.8
39. Wis.	111.98	104.21	110.33	6.12	5.9
40. Wyoming	10.19	9.83	10.08	.25	2.5
41. Processed	526.63	500.42	536.71	36.29	7.3
TOTAL	5418.18	5418.18	5850.47	432.29	0.8

[1] Average U.S. per capita consumption adjusted by index developed from USDA, 1955, Household Consumer Survey multiplied by the population in each area.

[2] Results from reactive programming analysis.

Arkansas, Oklahoma, and Mississippi. The total consumption in Mississippi is expected to decrease by nearly 10 trucklots per week, or 16 percent.

Total egg consumption for the United States is increasing but at a much slower rate than total population. This is a result of declining consumption level per person. Per capita consumption estimates for the base period were developed from the Household Consumer Survey data and were adjusted to the 1958-60 U.S. average consumption level. The adjusted per capita estimates and the equilibrium consumption levels per person by areas are shown in Table 3.

Table 3. Estimates of weekly per capita consumption of eggs, 1958-60 average and projected 1970, by areas, U.S.

	Household[1]	Equilibrium Estimates[2]		Changes	
Area	Survey Data	1958-60 week	1970 week	Amount	Percent
	—(eggs per person per week)—				
1. Alabama	(4) 6.42	6.42	5.87	—.55	— 8.6
2. Arizona	(5) 6.72	7.19	6.51	—.68	— 9.5
3. Arkansas	(4) 6.42	6.21	5.59	—.62	—10.0
4. California	(5) 6.72	*.90	6.25	—.65	— 9.4
5. Colorado	(5) 6.72	6.70	5.99	—.71	—10.6
6. Del., Md., D.C.	(4) 6.42	6.47	5.82	—.65	—10.0
7. Florida	(4) 6.42	6.61	6.02	—.59	— 8.9
8. Georgia	(4) 6.42	6.52	5.94	—.58	— 8.9
9. Idaho	(5) 6.72	6.60	5.98	—.62	— 9.4
10. Illinois	(3) 6.27	5.89	5.28	—.61	—10.4
11. Indiana	(3) 6.27	5.86	5.26	—.60	—10.2
12. Iowa	(3) 6.27	5.80	5.20	—.60	—10.3
13. Kansas	(3) 6.27	5.90	5.28	—.62	—10.5
14. Kentucky	(4) 6.42	6.03	5.41	—.62	—10.3
15. Louisiana	(4) 6.42	6.38	5.75	—.63	— 9.9
16. Michigan	(3) 6.27	6.22	5.58	—.64	—10.3
17. Minn.	(3) 6.27	5.60	5.02	—.58	—10.4
18. Miss.	(4) 6.42	6.28	5.66	—.62	— 9.9
19. Missouri	(3) 6.27	5.87	5.22	—.65	—11.1
20. Montana	(5) 6.72	6.47	5.81	—.66	—10.2
21. Nebraska	(3) 6.27	5.49	4.92	—.57	—10.4
22. Nevada-Utah	(5) 6.72	6.75	6.11	—.64	— 9.5
23. New England	(2) 5.32	5.59	5.02	—.57	—10.2
24. New Jersey	(2) 5.32	5.77	5.19	—.58	—10.1
25. New Mexico	(5) 6.72	6.88	6.16	—.72	—10.5
26. New York	(2) 5.32	5.56	4.99	—.57	—10.3
27. N.C.	(4) 6.42	6.37	5.73	—.64	—10.0
28. N.D.-S.D.	(3) 6.27	5.28	4.74	—.54	—10.2
29. Ohio	(3) 6.27	6.01	5.39	—.62	—10.3
30. Okla.	(4) 6.42	6.27	5.62	—.65	—10.4
31. Oregon	(5) 6.72	6.89	6.30	—.59	— 8.6
32. Penn.	(2) 5.32	5.51	4.95	—.56	—10.2
33. S.C.	(4) 6.42	6.53	5.95	—.58	— 8.9
34. Tenn.	(4) 6.42	6.09	5.48	—.61	—10.0
35. Texas	(4) 6.42	6.24	5.48	—.76	—12.2
36. Va.	(4) 6.42	6.28	5.65	—.63	—10.0
37. Wash.	(5) 6.72	7.05	6.53	—.52	— 7.4
38. West Va.	(4) 6.42	6.48	5.82	—.66	—10.2
39. Wis.	(3) 6.27	5.77	5.17	—.60	—10.4
41. Wyoming	(5) 6.72	6.40	5.74	—.66	—10.3
41 Processed	.66	.62	.56	—.06	— 9.7
U. S. Average	6.87	6.87	6.07	—.80	—11.6

[1] **Household Food Consumption Survey, 1955,** Reports No. 1-5, USDA.

[2] Reactive programming results converted to per capita estimates.

Intra- and Inter-Area Shipments and Net Prices

The available supplies in each producing area were allocated to the market areas that would yield the highest net price to the producing area. The volumes consumed within the producing areas are referred to as intra-area shipments and the volumes shipped among areas are referred to as inter-area shipments.

The intra- and inter-area shipments for the 1958-60 base week are shown in Table 4. The average net prices for the equilibrium shipments to the market areas specified in Table 4 are shown in Table

Table 4. Intra-and inter-area equilibrium shipments of eggs for 1958-60 average week, in 600-case trucklots.

Area	Intra-area shipments	Inter-area shipments[1]	Individual Inter-Area Shipments[2]
		—(Trucklots)—	
1. Alabama	92.94	—1.64	
2. Arizona	14.39	—24.30	
3. Arkansas	50.51	10.28	(15) 10.28
4. California	475.79	6.30	(2) 3.95 (22) 2.35
5. Colorado	27.56	—25.11	
6. Del.-Md.-D.C.	40.96	—63.43	
7. Florida	83.79	—52.10	
8. Georgia	115.77	12.98	(7) 12.98
9. Idaho	19.60	5.67	(22) 1.88 (31) 3.79
10. Illinois	241.21	—27.34	
11. Indiana	124.69	84.81	(26) 84.81
12. Iowa	73.79	359.91	(6) 18.92 (7) 4.13 (10) 27.34 (14) .95 (16) 81.45 (26) 67.95 (29) 40.77 (34) 11.46 (36) 21.26 (38) 24.53 (41) 61.15
13. Kansas	58.82	76.45	(15) 26.44 (30) 1.63 (35) 48.38
14. Kentucky	83.65	—.95	
15. Louisiana	40.68	—51.91	
16. Michigan	145.94	—81.45	
17. Minn.	86.89	237.80	(41) 237.80
18. Miss.	62.14	13.60	(15) 13.60
19. Missouri	117.09	38.22	(1) 1.64 (7) 34.99 (15) 1.59
20. Montana	19.90	—.38	
21. Nebraska	36.45	127.55	(2) 20.35 (5) 25.11 (25) 15.95 (41) 66.14
22. Nevada-Utah	31.80	—4.22	
23. New England	223.78	—37.49	
24. New Jersey	154.93	50.37	(6) 12.88 (23) 37.49
25. New Mexico	12.73	—15.95	
26. New York	184.77	—244.65	
27. N.C.	133.84	17.46	(33) 10.40 (36) 7.06
28. N.D.-S.D.	32.69	140.07	(20) .38 (37) .29 (40) 4.07 (41) 135.33
29. Ohio	224.02	—40.77	
30. Okla.	64.48	—1.63	
31. Oregon	53.04	—3.79	
32. Penn.	288.20	31.63	(6) 31.63
33. S.C.	61.49	—10.40	
34. Tenn.	86.39	—11.46	
35. Texas	227.03	—48.38	
36. Va.	85.95	—28.32	
37. Wash.	91.19	—.29	
38. West Va.	34.34	—24.53	
39. Wis.	104.21	91.89	(26) 91.89
40. Wyoming	5.76	—4.07	
41. Processed		—500.42	

[1] Positive figure denotes shipments from the specified area and negative figure denotes shipments into the specified area.

[2] Figure in parenthesis denotes areas and the corresponding figure denotes the volume.

5. In addition the net prices in the three best alternative market areas for each producing area are also shown in Table 5. The net prices in the alternative markets may be used as a guide for selecting the most profitable outlets if production in a particular area should be expanded since each of the best alternative market areas are deficit supply areas. The available supply in Mississippi during the base period exceeded the quantity demanded by 13.60 trucklots per week and the best outlet was Louisiana; the best alternative outlets for Mississippi were Florida, Alabama, and Tennessee.

The intra- and inter-area shipments for the 1970 projected week are shown in Table 6. The average net prices for the

Table 5. Average net trucklot prices for equilibrium shipments and net prices for three best alternative markets for 1958-60 average week.

Area	Average of[1] net prices	Net Prices in the Three Best Alternative Markets[2]		
			—(dollars per trucklot)—	
1. Alabama	9361	(7) 9256	(8) 9118	(33) 9107
2. Arizona	9457	(22) 9059	(25) 9059	(41) 8948
3. Arkansas	9145	(7) 9099	(1) 9095	(35) 9055
4. California	9126	(31) 9107	(37) 9061	(41) 8948
5. Colorado	9232	(2) 9112	(25) 9112	(22) 9032
6. Del., Md., D.C.	9417	(36) 9226	(26) 9221	(23) 9203
7. Florida	9528	(1) 9089	(33) 9089	(8) 9048
8. Georgia	9288	(1) 9188	(33) 9171	(36) 9075
9. Idaho	9161	(37) 9164	(2) 9062	(20) 8955
10. Illinois	9164	(16) 9071	(26) 9056	(14) 9057
11. Indiana	9109	(38) 9108	(16) 9105	(14) 9104
12. Iowa	8942	(15) 8942	(11) 8940	(30) 8922
13. Kansas	9022	(7) 8965	(1) 8963	(25) 8955
14. Kentucky	9275	(7) 9141	(38) 9134	(36) 9131
15. Louisiana	9346	(7) 9132	(1) 9100	(35) 9082
16. Michigan	9306	(26) 9167	(6) 9110	(38) 9099
17. Minn.	8947	(26) 8899	(38) 8894	(16) 8892
18. Miss.	9185	(7) 9176	(1) 9159	(34) 9043
19. Missouri	9028	(34) 9026	(14) 8998	(35) 8977
20. Montana	9246	(37) 9133	(31) 9069	(22) 8986
21. Nebraska	8943	(30) 8942	(35) 8939	(15) 8925
22. Nevada-Utah	9366	(2) 9150	(31) 9113	(37) 9093
23. New England	9469	(26) 9190	(6) 9152	(36) 9069
24. New Jersey	9253	(26) 9220	(36) 9166	(38) 9121
25. New Mexico	9315	(2) 9200	(22) 9046	(5) 9028
26. New York	9425	(23) 9234	(6) 9213	(36) 9151
27. N.C.	9202	(7) 9201	(6) 9186	(38) 9166
28. N.D.-S.D.	8950	(31) 8891	(22) 8889	(5) 8888
29. Ohio	9257	(26) 9163	(38) 9143	(6) 9139
30. Okla.	9226	(35) 9110	(15) 9067	(2) 9000
31. Oregon	9462	(37) 9302	(22) 9017	(41) 8948
32. Penn.	9281	(26) 9249	(23) 9219	(36) 9209
33. S.C.	9362	(7) 9255	(36) 9148	(6) 9137
34. Tenn.	9288	(7) 9177	(1) 9153	(33) 9110
35. Texas	9331	(15) 9097	(2) 9015	(30) 9006
36. Va.	9383	(6) 9260	(38) 9217	(26) 9193
37. Wash.	9492	(31) 9272	(22) 8967	(41) 8948
38. West Va.	9359	(36) 9241	(6) 9237	(26) 9199
39. Wis.	8973	(38) 8971	(16) 8968	(14) 8967
40. Wyoming	9218	(22) 9045	(2) 9034	(37) 9028
41. Processed				

[1] Average net prices for markets to which shipments were made as shown in Table 4.

[2] Fiigure in parenthesis denotes the area and the corresponding figure denotes net price.

equilibrium shipments to the markets specified in Table 6 are shown in Table 7; the three best alternative markets and the respective net prices are also shown in Table 7. The projected available supply in Mississippi exceeded the quantity demanded by 40.79 trucklots per week and the best outlet was Louisiana. The best alternative outlets for Mississippi were Texas, Tennessee and Kentucky.

Changes in the supply-demand situation from the base period to the projected period will result in considerable changes in the inter-area shipments. Consequently, major adjustments in the facilities for handling long distance shipments will be required if such shipments are to be handled efficiently.

The areas of Alabama, South Carolina and Washington were deficit during the

Table 6. Intra-and inter-area equilibrium shipments of eggs, 1970 projected week, in 600-case trucklots.

Area	Intra-area shipments	Inter-area shipments[1]	Individual Inter-Area Shipments[2]							
		—(Trucklots)—								
1. Alabama	89.00	38.76	(14)	5.96	(15)	12.19	(34)	20.61		
2. Arizona	18.22	—36.09								
3. Arkansas	37.17	23.60	(35)	23.60						
4. California	587.24	120.26	(2)	36.09	(22)	17.68	(41)	66.49		
5. Colorado	14.76	—46.21								
6. Del., Md., D.C.	24.33	—126.11								
7. Florida	139.46	—25.28								
8. Georgia	121.71	74.96	(7)	25.28	(36)	12.58	(38)	37.10		
9. Idaho	19.37	4.96	(22)	4.96						
10. Illinois	229.66	—48.11								
11. Indiana	139.13	82.79	(16)	18.23	(26)	64.56				
12. Iowa	69.21	427.98	(10)	48.11	(14)	18.86	(16)	107.22	(19)	33.29
			(29)	106.60	(35)	64.28	(41)	49.62		
13. Kansas	61.11	27.86	(35)	27.86						
14. Kentucky	54.56	—24.82								
15. Louisiana	45.40	—52.98								
16. Michigan	145.27	—125.45								
17. Minn.	89.65	265.12	(41)	265.12						
18. Miss.	52.36	40.79	(15)	40.79						
19. Missouri	77.88	—33.29								
20. Montana	18.02	—2.29								
21. Nebraska	36.19	127.81	(5)	46.21	(25)	2080	(30)	44.15	(35)	16.65
22. Nevada-Utah	22.70	—22.64								
23. New England	250.02	—9.42								
24. New Jersey	166.66	143.83	(23)	9.42	(26)	134.41				
25. New Mexico	11.30	—20.80								
26. New York	173.26	—289.14								
27. N.C.	136.44	75.10	(6)	39.29	(36)	35.81				
28. N.D.-S.D.	32.58	164.30	(20)	2.29	(40)	8.55	(41)	153.46		
29. Ohio	199.22	—106.60								
30. Okla.	10.79	—44.15								
31. Oregon	65.56	—1.93								
32. Penn.	286.87	96.50	(6)	79.64	(26)	16.86				
33. S.C.	77.41	7.18	(6)	7.18						
34. Tenn.	77.98	—20.61								
35. Texas	171.43	—132.39								
36. Va.	65.66	—48.39								
37. Wash.	104.57	3.95	(31)	1.93	(41)	2.02				
38. West Va.	17.20	—37.10								
39. Wis.	110.33	73.31	(26)	73.31						
40. Wyoming	1.53	—8.55								
41. Processed		—536.71								

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[1] Positive figures denote shipments from the specified area and negative numbers denote shipments into the specified area.

[2] Figures in parenthesis denotes areas and the corresponding figure denotes the volume.

base period but indications are that sizeable volumes will be shipped out during the projected period. Production in Missouri was in excess of consumption during the base period but it is expected to be a deficit area by 1970. The largest increases in shipments into areas are indicated for Texas, Ohio, and Delaware-Maryland- D. C. The largest decreases in the shipments into areas are indicated for New England, Florida, and South Carolina. The largest increases in shipments out of the area are indicated for California, New Jersey, and Iowa. The largest decreases in shipments out of the area are indicated for Kansas, Missouri and Wisconsin (Table 8).

Table 7. Average net trucklot prices for equilibrium shipments and net prices for three best alternative markets, 1970 projected week.

Area	Average of[1] net prices	Net Prices in Three Best Alternative Markets[2]					
				—(dollars per trucklot)—			
1. Alabama	9071	(7)	9059	(38)	9045	(36)	9033
2. Arizona	9353	(25)	9147	(41)	9003	(35)	8984
3. Arkansas	9147	(15)	9125	(30)	9075	(14)	9039
4. California	9020	(25)	8989	(5)	8866	(31)	8834
5. Colorado	9320	(25)	9201	(35)	9057	(40)	9038
6. Del., Md., D.C	9441	(26)	9282	(36)	9236	(23)	9228
7. Florida	9331	(41)	9003	(6)	9003	(36)	8995
8. Georgia	9088	(14)	9087	(6)	9085	(26)	9063
9. Idaho	9068	(25)	9035	(41)	9003	(20)	9003
10. Illinois	9225	(16)	9140	(14)	9123	(26)	9117
11. Indiana	9171	(14)	9170	(29)	9159	(38)	9144
12. Iowa	9007	(30)	9004	(26)	9003	(38)	8976
13. Kansas	9111	(30)	9111	(25)	9044	(5)	9018
14. Kentucky	9341	(38)	9171	(26)	9166	(6)	9144
15. Louisiana	9332	(35)	9177	(30)	9029	(41)	9003
16. Michigan	9374	(26)	9228	(29)	9147	(38)	9135
17. Minn.	9002	(26)	8960	(16)	8960	(14)	8958
18. Miss.	9163	(35)	9122	(34)	9030	(14)	9030
19. Missouri	9204	(35)	9072	(14)	9064	(30)	9049
20. Montana	9294	(41)	9003	(40)	9001	(25)	8944
21. Nebraska	9032	(41)	9003	(40)	8963	(19)	8957
22. Nevada-Utah	9269	(25)	9083	(2)	9047	(41)	9003
23. New England	9493	(26)	9251	(6)	9176	(36)	9079
24. New Jersey	9282	(6)	9274	(36)	9176	(38)	9157
25. New Mexico	9404	(5)	9117	(2)	9097	(35)	9080
26. New York	9486	(23)	9258	(6)	9236	(38)	9169
27. N.C.	9210	(38)	9202	(26)	9179	(14)	9111
28. N.D.-S.D.	9001	(5)	8977	(25)	8964	(35)	8891
29. Ohio	9317	(26)	9224	(16)	9204	(38)	9179
30. Okla.	9309	(35)	9205	(25)	9082	(15)	9052
31. Oregon	9190	(41)	9003	(22)	8920	(20)	8901
32. Penn.	9306	(23)	9244	(36)	9219	(38)	9210
33. S.C.	9160	(36)	9158	(38)	9152	(26)	9127
34. Tenn.	9275	(14)	9167	(38)	9113	(26)	9100
35. Texas	9426	(30)	9088	(15)	9083	(25)	9058
36. Va.	9394	(6)	9284	(38)	9254	(26)	9254
37. Wash.	9001	(20)	8935	(22)	8870	(25)	8814
38. West Va.	9395	(6)	9261	(26)	9260	(36)	9252
39. Wis.	9024	(29)	9022	(38)	9007	(41)	9003
40. Wyoming	9266	(25)	9093	(5)	9092	(20)	9029
41. Processed							

[1] Average net prices for markets to which shipments were made as shown in Table 6.

[2] Figure in parenthesis denotes the area and the corresponding figure denotes the net price.

Retail Prices

There were considerable differences between the average of the reported retail prices and the equilibrium retail prices for the base period. Differences in the reported retail prices among areas appear to be out of line in that they cannot be explained by cost of transportation. For example, the average of the reported retail prices per dozen for New Jersey, with excess supplies was 61.0 cents while the reported price for New York, a deficit area, was 57.9 cents. In contrast, equilibrium prices are higher in deficit areas and the differences between areas cannot exceed the transportation cost. As a result of using a constant price level and the demand and supply projections, there is little difference in the equilibrium price levels for the base and projected

Table 8. Comparisons of inter-area equilibrium trucklot shipments of eggs for 1958-60 and 1970.

	Shipments In			Shipments Out		
Area	1958-60	1970	Change[1]	1958-60	1970	Change[1]
		Trucklots			Trucklots	
1. Alabama	1.64		—1.64		38.76	38.76
2. Arizona	24.30	36.09	11.79			
3. Arkansas				10.28	23.60	13.32
4. California				6.30	120.26	113.96
5. Colorado	25.11	46.21	21.10			
6. Del., Md., D.C.	63.43	126.11	62.68			
7. Florida	52.10	25.28	—26.82			
8. Georgia				12.98	74.96	61.98
9. Idaho				5.67	4.96	—.71
10. Illinois	27.34	48.11	20.77			
11. Indiana				84.81	82.79	—2.02
12. Iowa				359.91	427.98	67.08
13. Kansas				76.45	27.86	—45.89
14. Kentucky	.95	24.82	23.87			
15. Louisiana	51.91	52.98	1.07			
16. Michigan	81.45	125.45	44.00			
17. Minn.				237.80	265.12	27.32
18. Miss.				13.60	40.79	27.19
19. Missouri		33.29	33.29	38.22		—38.22
20. Montana	.38	2.29	1.91			
21. Nebraska				127.55	127.81	.26
22. Nevada-Utah	4.22	22.64	18.42			
23. New England	37.49	9.42	—28.07			
24. New Jersey				50.37	143.83	93.46
25. New Mexico	15.95	20.80	4.85			
26. New York	244.65	289.14	44.49			
27. N.C				17.46	75.10	57.64
28. N.D.-S.D.				140.07	164.30	24.23
29. Ohio	40.77	106.60	65.83			
30. Okla	1.63	44.15	42.52			
31. Oregon	3.79	1.93	—1.86			
32. Penn.				31.63	96.50	64.87
33. S.C.	10.40		—10.40		7.18	7.18
34. Tenn.	11.46	20.61	9.15			
35. Texas	48.38	132.39	84.01			
36. Va.	28.32	48.39	20.07			
37. Wash.	.29		—.29		3.95	3.95
38. West Va.	24.53	37.10	12.57			
39. Wis.				91.89	73.31	—18.58
40. Wyoming	4.07	8.55	4.48			
41. Processed	500.42	536.71	36.29			
TOTAL	1,304.98	1,799.06		1,304.99	1,799.06	

[1] Changes from 1958-60 to 1970.

periods. The average of the reported retail prices and equilibrium retail prices in cents per dozen are shown by areas in Table 9.

Excess-Deficit Supplies, Prices and Flows, 1958-60

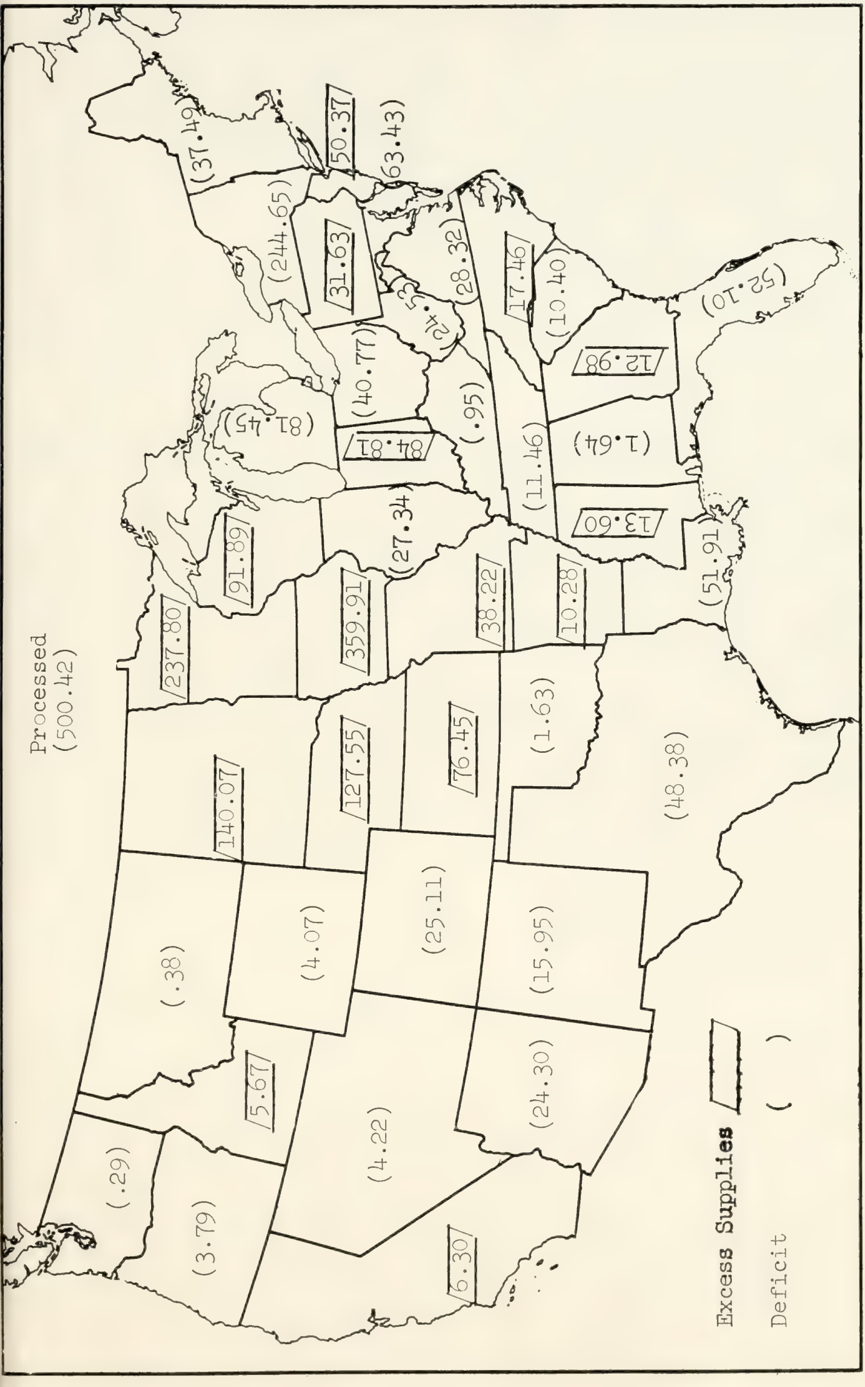
The excess and deficit supplies of eggs tend to be concentrated by geographic regions of the U.S. In 1958-60 the heaviest concentration of excess supplies was in Iowa and adjacent areas to the north, south, and west. The major deficit areas were in the Northeastern and Southwestern Regions. The excess and deficit supplies for 1958-60 are shown, by areas, in Figure 1.

Equilibrium prices are closely related to the excess-deficit supply situations. In general, higher prices are associated with deficit areas and lower prices are associated with excess areas. The equilibrium price for the more remote deficit areas of

Table 9. Retail prices per dozen: Average reported and equilibrium 1958-60 and equilibrium 1970.

Area	Reported prices[1]	Equilibrium Prices 1958-60	Equilibrium Prices 1970	Change Amount	Change Percent
		—(cents per dozen)—			
1. Alabama	52.6	52.01	50.42	—1.59	—3.1
2. Arizona	52.6	52.54	51.96	—.58	—1.1
3. Arkansas	48.4	50.84	50.81	—.03	—0.1
4. California	54.3	50.71	50.13	—.58	—1.1
5. Colorado	52.7	51.29	51.78	.49	1.0
6. Del., Md., D.C.	53.8	52.32	52.45	.13	0.2
7. Florida	57.2	52.93	51.84	—1.09	—2.1
8. Georgia	54.3	51.62	50.49	—1.13	—2.2
9. Idaho	51.0	50.88	50.39	—.49	—1.0
10. Illinois	46.3	50.91	51.25	.34	0.7
11. Indiana	45.5	50.59	50.93	.34	0.7
12. Iowa	43.6	49.70	50.40	.34	0.7
13. Kansas	46.0	50.14	50.59	.45	0.9
14. Kentucky	46.9	51.53	51.90	.37	0.7
15. Louisiana	52.5	51.92	51.84	—.08	—0.2
16. Michigan	51.8	51.70	52.08	.38	0.7
17. Minn.	41.5	49.70	50.00	.30	0.6
18. Miss.	50.3	51.07	50.91	—.16	—0.3
19. Missouri	45.6	50.14	51.14	1.00	2.0
20. Montana	50.1	51.37	51.63	.26	0.5
21. Nebraska	39.9	49.68	50.18	.50	1.0
22. Nevada-Utah	51.5	52.03	51.49	—.54	—1.0
23. New England	58.8	52.60	52.74	.14	0.3
24. New Jersey	61.0	51.39	51.57	.18	0.4
25. New Mexico	56.2	51.75	52.24	.49	0.9
26. New York	57.9	52.36	52.70	.34	0.6
27. N.C.	51.6	51.12	51.18	.06	0.1
28. N.D.-S.D.	37.5	49.73	50.00	.27	0.5
29. Ohio	48.6	51.43	51.76	.33	0.6
30. Okla.	50.6	51.26	51.71	.45	0.9
31. Oregon	56.1	52.57	51.06	—1.51	—2.9
32. Penn.	56.1	51.56	51.68	.12	0.2
33. S.C.	55.3	52.01	50.89	—1.12	—2.2
34. Tenn.	48.0	51.60	51.53	—.07	—0.1
35. Texas	50.3	51.84	52.37	.53	1.0
36. Va.	51.1	52.13	52.19	.06	0.1
37. Wash.	58.8	52.73	50.00	—2.73	—5.2
38. West Va.	53.8	51.99	52.19	.20	0.4
39. Wis.	43.3	49.84	50.13	.29	0.6
40. Wyoming	51.6	51.21	51.48	.27	0.5
41. Processed		49.71	50.02	.31	0.6

[1] **Agricultural Prices,** March 15, 1960, p. 35 and August 15, 1962, p. 26.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Excess Supplies
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Figure 1. Excess and deficit supplies of eggs for equilibrium condition, 1958-60 (600 case truck lots)

New England, Florida, Arizona, Oregon, and Washington was 53 cents per dozen. The equilibrium prices in the major excess region in the vicinity of Iowa was 50 cents per dozen. The equilibrium price surface for 1958-60 is shown in Figure 2.

The flows of eggs from excess areas to deficit areas are also closely related to prices. As would be expected, the equilibrium flows are from low price, excess, areas to the higher price, deficit, areas. The equilibrium price surface and flows for 1958-60 are shown in Figure 3.

Excess-Deficit Supplies, Prices and Flows, 1970

It was pointed out earlier that considerable changes in the excess-deficit situation would be expected from 1958-60 to 1970 for some areas. The individual area changes also altered the regional situation. The geographic size of the major excess supply region is expected to be reduced because a deficit situation is indicated for Missouri. An excess supply region appears to be developing in the Southern areas from Mississippi to North Carolina except for Florida. The major deficit areas in 1970 are expected to be in the Northeastern and Southwestern regions of the U.S. The excess and deficit areas for 1970 are shown in Figure 4.

The retail price surface for the 1970 projection is characterized by high prices in the Northeast, Florida, the Southwest, Oregon and Montana. The low prices are indicated for Iowa and adjacent areas, west and north, Alabama-Georgia and California. The retail prices for 1970 in cents per dozen are shown in Figure 5.

Indications are that considerable volumes of eggs from the low price, excess, areas of Alabama and Georgia will be flowing northward into areas formerly supplied by the Iowa area. The equilibrium flows of eggs for the 1970 projected situation are shown in Figure 6.

Limitations and Implications

Any conclusion drawn from this study with respect to prices and cost will be in terms of 1958-60 dollars. Costs for assembling and distributing eggs within the respective areas were considered as a constant which applied to all areas. Therefore inferences can be drawn with respect to wholesale and farm prices because they would follow the same pattern as retail prices except at lower levels. Results for 1970 are based on **projected** supply and demand conditions.

During the period of 1958-60 to 1970, weekly per capita consumption of eggs is expected to decline from 6.87 to 6.07, a decrease of 12 percent. However, population is expected to increase by 20 percent and as a result the total quantity of eggs demanded and produced are expected to increase about eight percent.

From a careful study of prices shown in this report one may well conclude that technological developments in the transporation industry have virtually eliminated the transportation cost advantages of location for the table egg industry. The future location of the egg industry will be highly dependent upon the technology employed in production and the corresponding cost. Transportation cost will likely continue to exert a smaller and smaller influence on production location.

Some specific conclusions may be drawn for each of the specified areas as illustrated for Mississippi. For the period under consideration, supplies are expected to increase by 23 percent and quantities demanded or consumed within the area are expected to decrease by 16 percent. Weekly supplies of eggs in Mississippi exceeded the quantity consumed by 13.6 trucklots in 1958-60 and the excess production is expected to increase to about 41 trucklots by 1970. Louisiana was the best outlet for the excess supplies in 1958-60 and Louisiana is expected to be the best outlet in 1970. The three best alternative outlets for Mississippi in 1958-60 were Florida, Alabama and Tennessee. The three best alternative outlets indicated for 1970 are Texas, Tennessee,

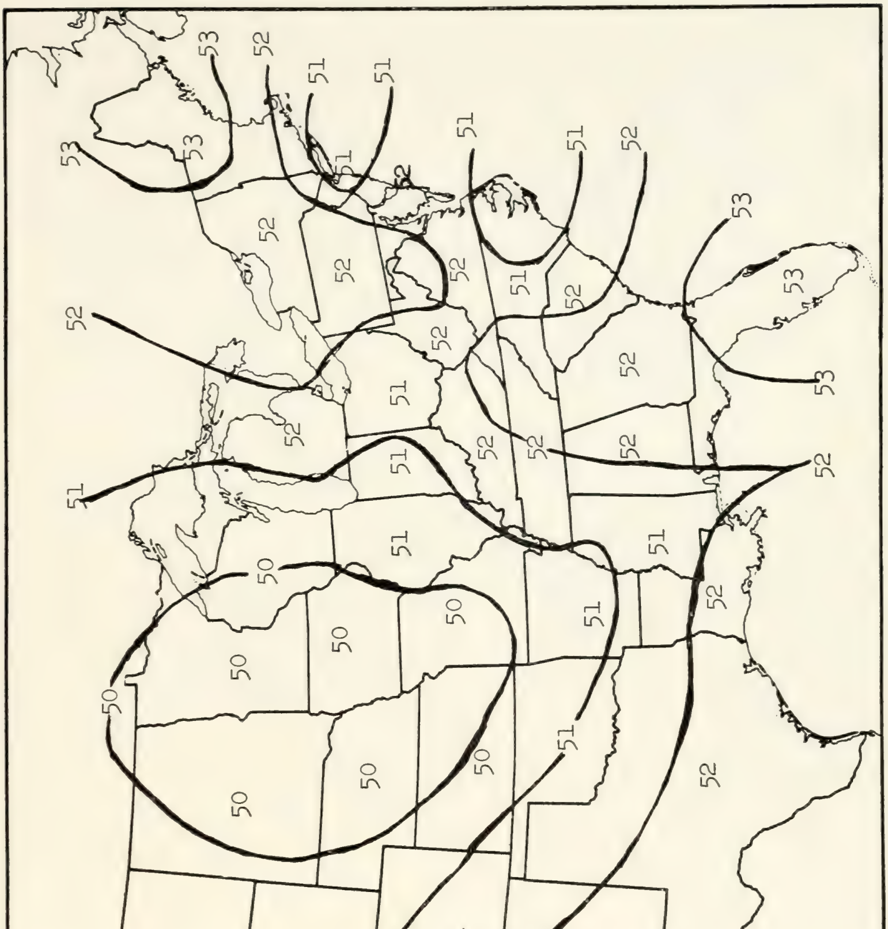
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Figure 2. Equilibrium retail egg prices in cents per dozen, 1958-60.

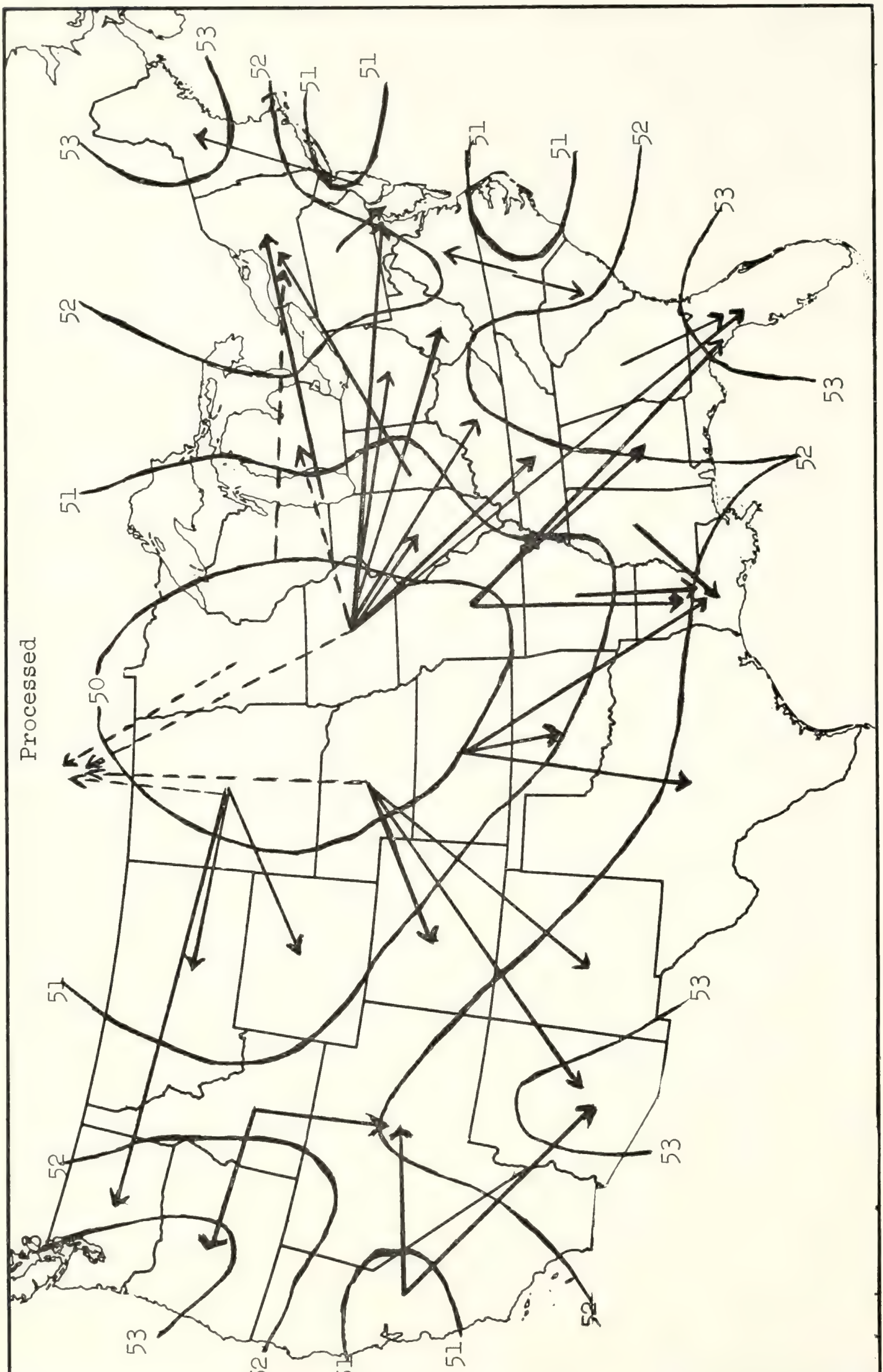
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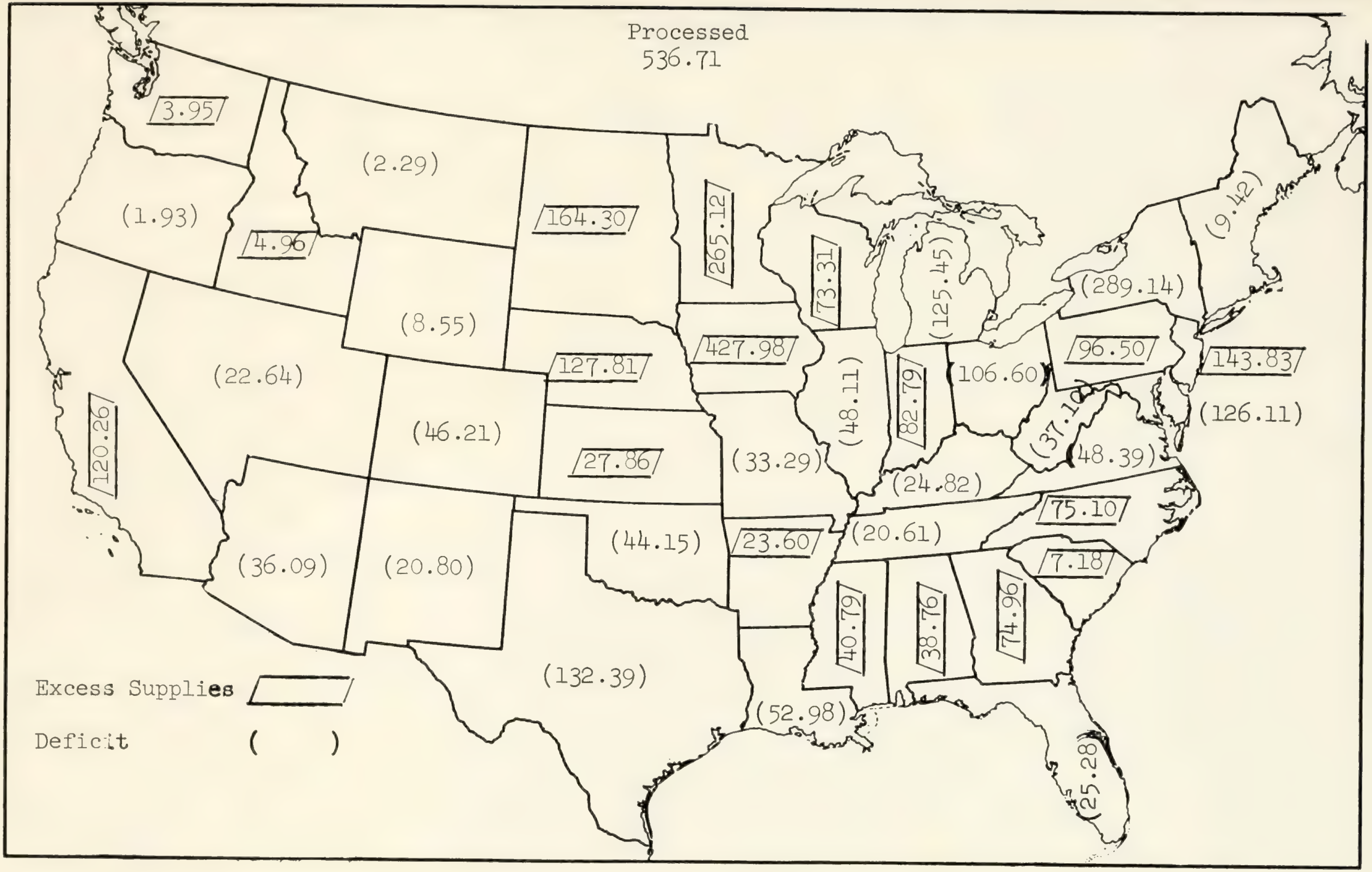
Figure 3. Equilibrium egg prices and flows, 1958-60.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Excess Supplies
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Figure 4. Excess and deficit supplies of eggs for equilibrium condition, 1970 (600 case truck lots)

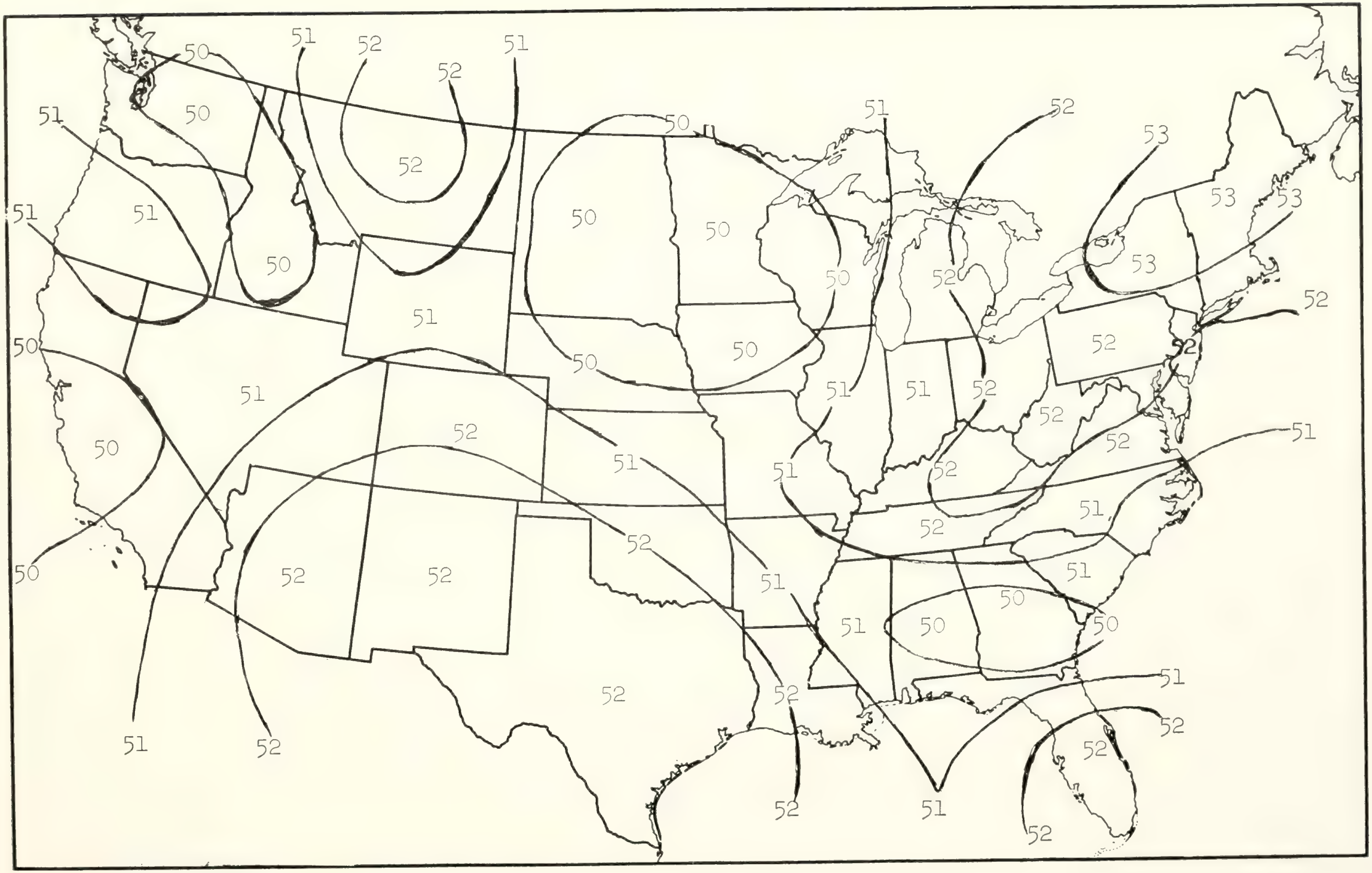
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Figure 5. Equilibrium retail egg prices in cents per dozen, 1970 projection.

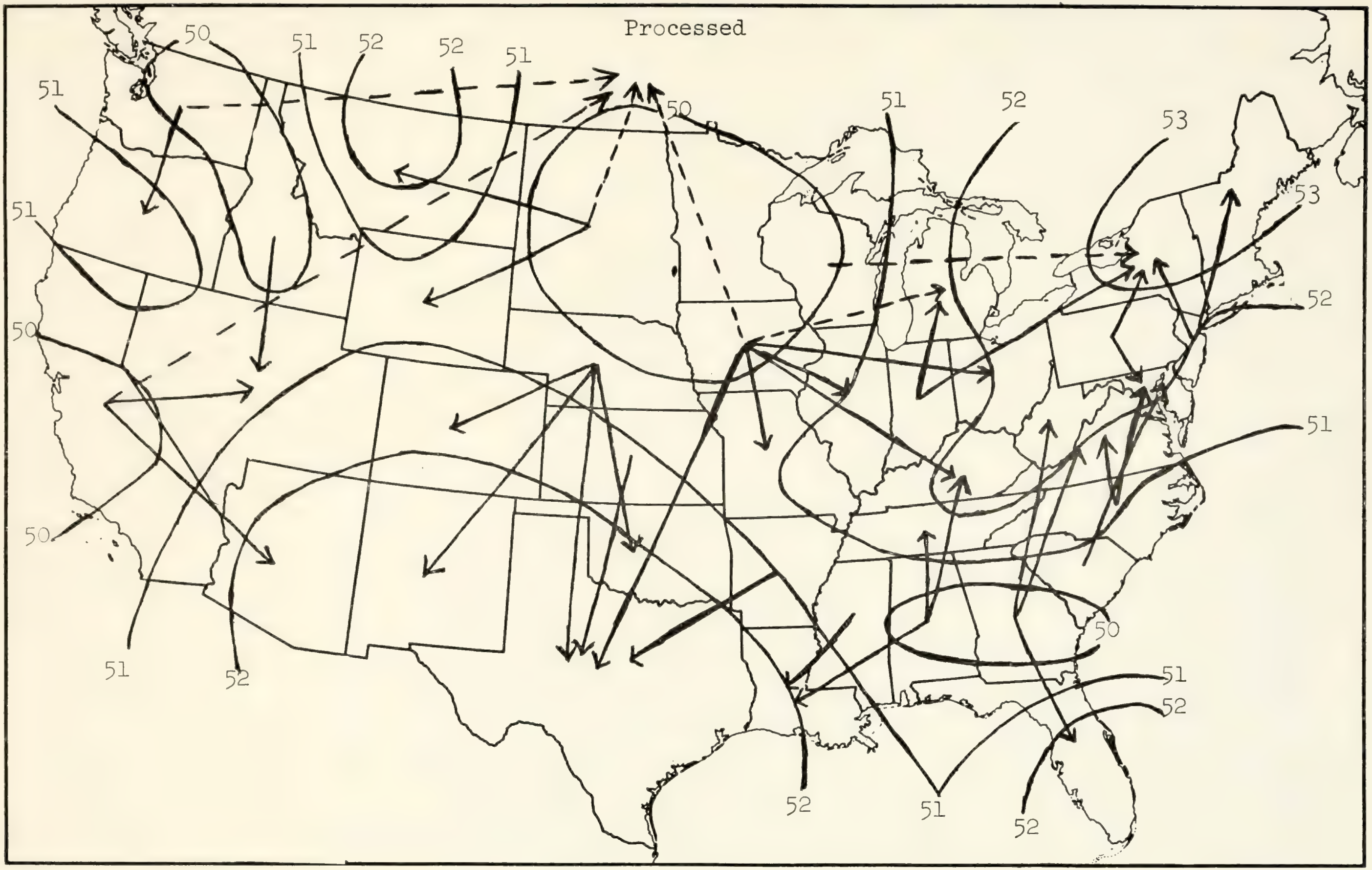
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Figure 6. Equilibrium egg prices and flows, 1970 projection.

and Kentucky.

In terms of 1958-60 price levels, no significant changes are anticipated at the retail, wholesale, or farm level. Thus revenues to the egg industry of Mississippi are expected to increase in proportion to the supply or an increase of about 23 percent.

APPENDIX

Supplies for 1958-60

The estimation of egg supplies for consumption required several adjustments in the reported data because reported production by areas (states) included eggs used for hatching and excluded production by nonfarm backyard flocks. Farm production estimates for 1958, 1959 and 1960 were reduced to an average annual level. Production by nonfarm backyard flocks was estimated to be four percent of the U.S. farm production. This quantity was allocated to each of the areas in proportion to the population in the respective areas. The average number of eggs used for hatching in the U.S. during this period was allocated to the respective areas in proportion to the number of hens tested for pullorum in each of the respective areas. Thus annual average supplies for consumption for each area were estimated as farm production plus production by nonfarm backyard flocks less eggs used for hatching. Weekly consumption was estimated as annual supplies for consumption divided by weeks per year. Dividing the weekly estimates of consumption by the number of eggs per trucklot (216,000) yielded trucklots per week. The basic data for 1958-60 and trucklots per week are shown in Appendix Table 1.

Supplies for 1970

Supply estimates for 1970 were developed by evaluating and projecting production trends within each of the areas. Production trends for each producing area were evaluated by regression procedures for the period 1925-60 and for 1946-60 using production as the dependent variable and year as the independent variable. The independent variable was coded so that 1925 had a value of one and 1960 had a value of 36. For each series of data for each area the following equations were fitted:

(1) Production = a + b (year)

(2) Log_e production = a + b (year)

Results from the four analyses for each area were compared but the statistical measures did not provide a basis for selection; however, projections for 1970 from equation (1) based on data from 1946-60 were more consistent with trends in per capita consumption and projected population. Therefore the projected supply for each area was based on the average production and the absolute annual average change from 1946-70 for each of the respective areas. The equations used to project the supplies and the projected supplies in trucklot quantities are shown in Appendix Table 2. The total production estimated from these equations was reduced to an average week and converted to trucklots as indicated above.

The projections for 1970 are shown in Appendix Table 3. These estimates included eggs to be used for hatching, consequently, they were adjusted downward to the proportion of eggs used for consumption in 1958-60. Also the projected supplies were adjusted to projected demand because the sum of the 41 independent estimates of the projected quantity demanded in 1970 was only 1.8 percent more than the sum of the 40 independent estimates of supply; therefore, it appeared that producers were adjusting to changes in demand as rapidly as such changes were recognized. Because of these apparent rapid adjustments, projected supplies were adjusted upward to correspond with the projected demand. The projections for 1970 are shown in Appendix Table 3.

Demand for 1958-60

Consumption: The total supply of eggs produced for consumption in the U.S. was divided by the population yielding a per capita consumption estimate of 357 eggs per year or 6.87 eggs per week. Shell eggs accounted for about 90 percent of the consumtion or 6.21 eggs per week and processed eggs accounted for .66 eggs per week. Regional per capita consumption indices were developed from the 1955 USDA Household Food Consumption Survey. These estimates were adjusted to 1958-60 consumption levels and applied to the population reported for each consumption area in order to obtain an estimate of total consumption in each area.

Prices and Demand Functions: Prices paid for eggs in retail stores in March, June, September, and December were averaged to obtain an estimate of the average annual price per dozen in each consuming area. Prices per dozen were converted to price for trucklots (18,000 dozen eggs).

The elasticity of demand used in this study was -.55 which is the average of the elasticities reported from several previous studies.[1] The reciprocal of this estimate, - 1.81818, was used as an estimate of the price flexibility or the effect of a one percent change in quantity on price.

The estimates of prices, consumption, and price flexibility for each consuming area were used to develop a demand functions of the following form:

(1) Log_e Price = A + (-1.81818) ($\log_e$ quantity).

Since A was the only unknown for each area, the equations could be readily solved. The **A** values for the demand equations are shown in Appendix Table 4.

Demand for 1970

The 1958-60 equilibrium quantity for each area was adjusted in proportion to the changes in population from 1959 to 1970 as estimated by the Bureau of the Census. These results were adjusted downward by the projected trend in per capita egg consumption (projection of linear trends from 1946 to 1960). The quantities thus obtained were considered as estimates of the quantity that would be purchased in 1970 at the 1958-60 equilibrium prices. The price flexibility estimate of -1.81818 was then used in conjunction with these estimates of prices and quantities to solve for an **A** value for the price equation for each area. The **A** values for the demand equation are shown in Table 4.

Transportation Cost

Transportation costs from each producing area to each consuming area were developed from data provided by a commercial transportation firm.[2] Usual regression procedures were used to estimate the effect of air miles on reported charges between specified points. Air miles explained 85 percent of the variation in reported charges and yielded the following estimates:

Cost per trucklot = \$107.210 + \$.419 (air miles).

Several cost estimates developed from this equation were very close to charges paid by some egg marketing firms in Mississippi. This equation was used to develop a complete cost matrix among the producing and consuming areas.

The central points used to compute air mileages from each producing area to each consuming area are shown in Appendix Table 5.

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[1] Gerra, Martin J. **The Demand and Price Structure for Eggs.** USDA Technical Bulletin 1024, pp. 81-82.

[2] Refrigerated Transport Company, Atlanta, Georgia.

Appendix Table 1. Basic data used to estimate weekly supplies of eggs for 1958-60.

Area	Farm Production[1]	Non Farm Production	Hatching Eggs	Supply for Consumption
		(Millions of eggs per year)		(Trucklot)
1. Alabama	1161	45	162	92.94
2. Arizona	146	17	1	14.39
3. Arkansas	798	25	140	60.79
4. California	5262	211	58	482.09
5. Colorado	290	24	4	27.56
6. Del., Md., D.C.	487	50	77	40.69
7. Florida	901	63	23	83.79
8. Georgia	1833	54	441	128.75
9. Idaho	281	9	6	25.27
10. Illinois	2679	140	110	241.21
11. Indiana	2507	65	219	209.50
12. Iowa	4957	39	125	433.69
13. Kansas	1526	31	38	135.27
14. Kentucky	928	43	31	83.65
15. Louisiana	441	45	29	40.68
16. Michigan	1557	112	30	145.94
17. Minn.	3748	48	149	324.69
18. Miss.	952	30	131	75.74
19. Missouri	1869	61	186	155.30
20. Montana	220	10	6	19.90
21. Nebraska	1858	20	36	164.00
22. Nevada-Utah	348	16	7	31.80
23. New England	2745	143	374	223.78
24. New Jersey	2274	82	50	205.31
25. New Mexico	130	13		12.73
26. New York	1890	237	52	184.77
27. N.C.	1975	64	340	151.30
28. N.D.-S.D.	1957	19	36	172.76
29. Ohio	2438	135	57	224.02
30. Okla.	711	32	19	64.48
31. Oregon	609	25	38	53.04
32. Penn.	3564	161	133	319.83
33. S.C.	695	34	38	61.49
34. Tenn.	960	49	39	86.39
35. Texas	2455	136	41	227.03
36. Va.	1011	56	102	85.95
37. Wash.	1025	40	41	91.19
38. West Va.	369	28	11	34.34
39. Wis.	2188	55	40	196.10
40. Wyoming	60	5		5.76
Total	61805	2472	3420	5418.18

[1] Sources: Based on data from **Egg and Poultry Statistics,** Statistical Bul. Nos. 305 and 249, March 1962 and December 1960 pages 79 and 48 respectively.

Appendix Table 2. Constants for equations used to predict total egg production for 1970.

Area	a	b	r
1. Alabama	—370.433	43.489	.877
2. Arizona	—62.400	5.786	.864
3. Arkansas	492.167	6.561	.299
4. California	—2187.833	218.946	.988
5. Colorado	666.000	—10.886	.936
6. Del., Md. D.C.	1007.000	—15.200	.931
7. Florida	—1056.800	57.171	.962
8. Georgia	—1692.300	99.754	.928
9. Idaho	282.833	—.255	.098
10. Illinois	3127.800	—11.000	.299
11. Indiana	1887.467	17.593	.646
12. Iowa	3240.900	51.596	.866
13. Kansas	2990.900	—43.154	.939
14. Kentucky	1870.033	—27.125	.938
15. Louisiana	181.200	7.686	.780
16. Michigan	1503.567	2.682	.146
17. Minn.	3569.300	11.125	.240
18. Miss.	—94.267	28.229	.706
19. Missouri	4432.900	—75.818	.961
20. Montana	266.567	—1.382	.541
21. Nebraska	1761.433	1.775	.103
22. Nevada-Utah	603.536	7.063	.797
23. New England	2001.300	24.875	.678
24. New Jersey	—20.867	76.364	.764
25. New Mexico	120.600	.100	.053
26. New York	2254.833	—6.375	.357
27. N.C.	—581.000	73.579	.964
28. N.D.-S.D.	1144.973	23.618	.899
29. Ohio	2783.866	—11.436	.617
30. Okla.	2284.466	—47.007	.973
33. S.C.	—185.433	24.854	.909
31. Oregon	262.233	10.961	.841
32. Penn.	1699.633	24.854	.909
34. Tenn.	1203.300	—6.761	.781
35. Texas	3592.200	—36.357	.709
36. Va.	1375.566	—12.439	.490
37. Wash.	165.733	23.436	.903
38. West Va.	784.467	—12.829	.882
39. Wis.	2526.466	—10.257	.448
40. Wyoming	186.633	—3.682	.969
41. Processed			
TOTAL	43928.767	531.811	.939

[1] Total egg production (mil.)=a + b X; where X denotes year (1946=21 and 1970=46).

Appendix Table 3. Egg supply projections for average week 1970.

Area	Total Production[1]	Percent for Consumption	Supply for Consumption	Supply adjusted to consumption
	(trucklots)	(percent)	(trucklots)	(trucklots)
1. Alabama	145.2	86.4	125.5	127.76
2. Arizona	18.1	98.7	17.9	18.22
3. Arkansas	70.7	84.4	59.7	60.77
4. California	702.0	99.0	695.0	707.50
5. Colorado	14.7	98.8	14.5	14.76
6 Del., Md., D.C.	27.4	87.1	23.9	24.33
7. Florida	140.1	97.8	137.0	139.46
8. Georgia	257.9	74.9	193.2	196.67
9. Idaho	24.3	98.5	23.9	24.33
10. Illinois	233.5	96.6	225.6	229.66
11. Indiana	240.1	90.8	218.0	221.92
12. Iowa	499.9	97.7	488.4	497.19
13. Kansas	89.6	97.6	87.4	88.97
14. Kentucky	55.4	96.8	53.6	54.56
15. Louisiana	47.6	93.7	44.6	45.40
16. Michigan	144.9	98.5	142.7	145.27
17. Minn.	363.4	95.9	348.5	354.77
18. Miss.	107.2	85.4	91.5	93.15
19. Missouri	84.2	90.9	76.5	77.87
20. Montana	18.1	97.7	17.7	18.02
21. Nebraska	164.1	98.2	161.1	164.00
22. Nevada-Utah	22.6	98.8	22.3	22.70
23. New England	280.1	87.7	245.6	250.02
24. New Jersey	310.9	98.1	305.0	310.49
25. New Mexico	11.1	100.0	11.1	11.30
26. New York	174.7	97.4	170.2	173.26
27. N.C.	249.7	83.3	208.0	211.74
28. N.D.-S.D.	198.7	97.3	193.4	196.88
29. Ohio	201.1	97.3	195.7	199.22
30. Okla.	10.9	97.6	10.6	10.79
31. Oregon	68.2	94.5	64.4	65.56
32. Penn.	390.7	96.4	376.6	383.37
33. S.C.	85.3	97.4	83.1	84.59
34. Tenn.	79.5	96.3	76.6	77.98
35. Texas	171.0	98.5	168.4	171.43
36. Va.	71.5	90.2	64.5	65.66
37. Wash.	110.8	96.2	106.6	108.52
38. West Va.	17.3	97.4	16.9	17.20
39. Wis.	183.0	98.6	180.4	183.64
40. Wyoming	1.5	100.0	1.5	1.53
41. Processed				
TOTAL	6090.1	94.9	5747.1	5850.47

[1] Estimates from equations in Appendix Table 2, reduced to average week and converted to trucklots.

Appendix Table 4. Constant price equations for eggs for average week in 1958-1960 and 1970.

Area		A Values	
		1958-1960	1970
1.	Alabama	17.416007	17.274472
2.	Arizona	15.800939	16.406668
3.	Arkansas	16.252678	15.694576
4.	California	20.328065	20.699324
5.	Colorado	16.337794	16.613406
6.	Del., Md. D.C.	17.601467	18.268402
7.	Florida	18.092638	18.421762
8.	Georgia	17.776114	17.845029
9.	Idaho	14.532974	14.501442
10.	Illinois	19.292215	19.360263
11.	Indiana	17.890959	18.096918
12.	Iowa	16.919348	16.809752
13.	Kansas	16.516062	16.594297
14.	Kentucky	17.204165	17.095462
15.	Louisiana	17.375788	17.484402
16.	Michigan	19.005003	19.329474
17.	Minn.	17.216509	17.279324
18.	Miss.	16.634087	16.319682
19.	Missouri	17.767595	17.693007
20.	Montana	14.603967	14.611840
21.	Nebraska	15.636589	15.633533
22.	Nevada-Utah	15.661600	16.069268
23.	New England	19.274932	19.264739
24.	New Jersey	18.301437	18.437691
25.	New Mexico	15.241700	15.455914
26.	New York	20.173737	20.314722
27.	N.C	18.030062	18.068843
28.	N.D.-S.D.	15.439676	15.438940
29.	Ohio	19.276674	19.545005
30.	Okla	16.750362	16.422810
31.	Oregon	16.500516	16.784101
32.	Penn.	19.433185	19.427118
33.	S.C.	16.917486	17.030181
34.	Tenn.	17.469797	17.482271
35.	Texas	19.356087	19.544699
36.	Va.	17.762242	17.759807
37.	Wash.	17.369283	17.559171
38.	West Va.	16.553622	16.410614
39.	Wis.	17.549742	17.659415
40.	Wyoming	13.284404	13.336020
41.	Processed	20,40000	20.533399

[1] Log_e Price per trucklot = A + (—1.81818) (Log_e Quality)

Appendix Table 5. Central points for areas used to compute egg transportation cost.

Area	City	Latitude N	Longitude W
1. Alabama	Montgomery	32.21	86.18
2. Arizona	Casa Grande	32.51	111.45
3. Arkansas	Little Rock	34.43	92.16
4. California	Fresno	36.44	119.48
5. Colorado	Colorado Springs	38.49	104.49
6. Del., Md., D.C.	Baltimore	39.18	76.38
7. Florida	Orlando	28.33	81.22
8. Georgia	Macon	32.49	83.39
9. Idaho	Twin Falls	42.33	114.29
10. Illinois	Decatur	39.51	88.58
11. Indiana	Indianapolis	39.45	86.10
12. Iowa	Des Moines	41.32	93.32
13. Kansas	Emporia	38.24	96.11
14. Kentucky	Danville	37.48	84.48
15. Louisiana	Alexandria	31.18	92.26
16. Michigan	Lansing	42.45	84.35
17. Minn.	Minneapolis, St. Paul	44.57	93.15
18. Miss.	Jackson	32.17	90.12
19 Missouri	Jefferson City	38.35	92.12
20. Montana	Lewistown	47.50	109.27
21. Nebraska	Columbus	41.25	97.21
22. Nevada-Utah	Ely, Nev.	39.16	114.53
23. New England	Concord, N.H.	43.12	71.32
24. New Jersey	Fruhold	40.16	74.15
25. New Mexico	Albuqerque	35.50	106.39
26. New York	Cortland	42.36	79.90
27. N.C.	High Point	35.57	80.00
28. N.D.-S.D.	Linton, N.D.	46.16	100.15
29. Ohio	Marion	40.37	83.70
30. Okla.	Oklahoma City	35.28	97.31
31. Oregon	Salem	44.56	123.10
32. Penn.	Harrisburg	40.16	76.50
33. S.C.	Camden	34.15	80.37
34. Tenn.	Murfreesboro	35.51	86.24
35. Texas	Waco	31.35	97.70
36. Va.	Charlottesville	38.20	78.29
37. Wash.	Seattle	47.45	122.25
38. West Va.	Elkins	38.54	79.50
39. Wis.	Madison	43.50	89.22
40. Wyoming	Casper	42.51	106.18